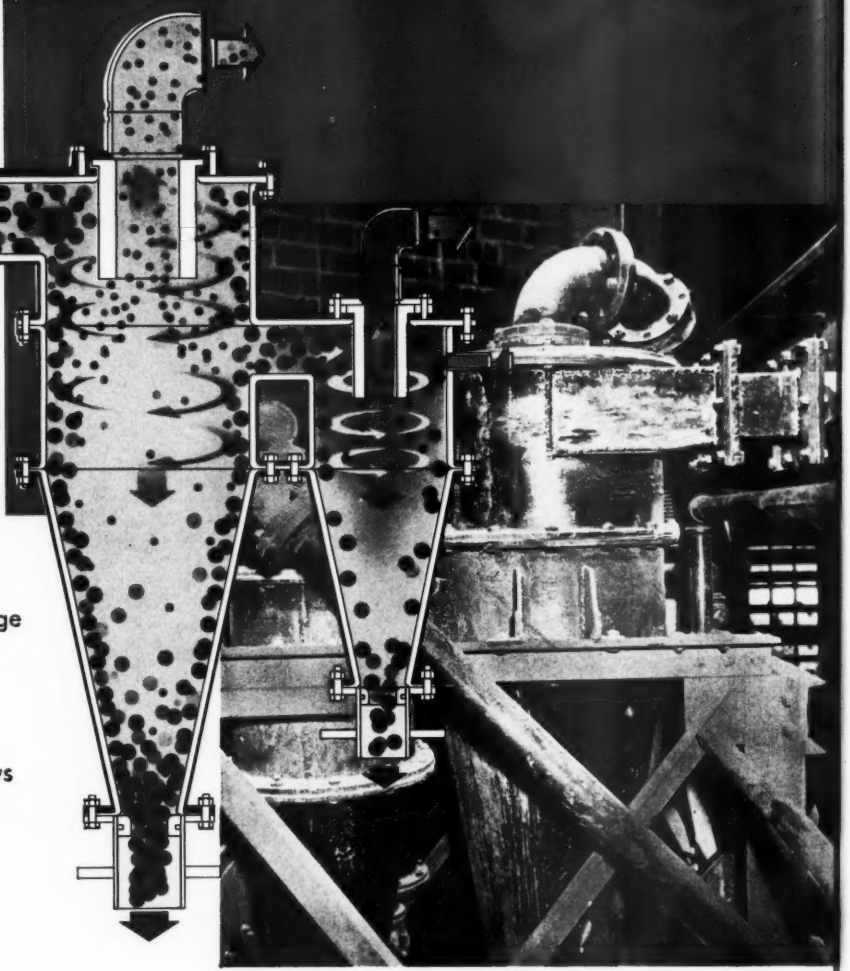
MINING CONGRESS JOURNAL

OCTOBER 1959

POST-CONVENTION ISSUE

DENVER - MORTON DUPLEX* CYCLONE CLASSIFIER

*PATENTED



Now!...

from DENVER...

a specially engineered DUPLEX Cyclone Classifier that—

(1) Produces Cleaner, Higher Density Sand Product

than is possible with single-stage conventional wet cyclones.

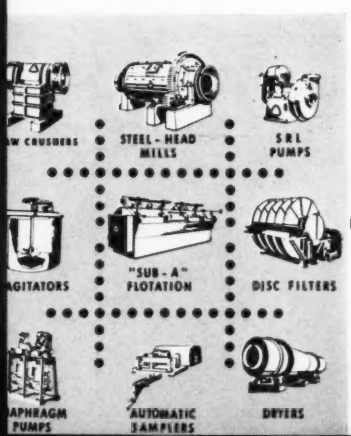
(2) Is Self Regulating

—handles surges or peak flows that would plug conventional wet cyclones.

(3) Uses Water to Wash Slimes From Sand

to give sharp separation, clean, slime-free product.

Complete details on the DENVER-Morton Duplex Cyclone Classifier will be sent to you on request. Write today!



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MINING CONGRESS JOURNAL

VOL. 45 **October 1959** **No. 10**

Indexed regularly by Engineering Index, Inc.

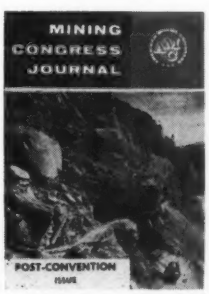
CONTENTS

Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

ON OUR COVER

A typical uranium mine in the Colorado Plateau is located in a remote area necessitating truck haulage to the mill. For complete story on Union Carbide Nuclear Co. operations see pages 94 to 96.



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ROOF BOLTING THAT INCREASES PRODUCTION

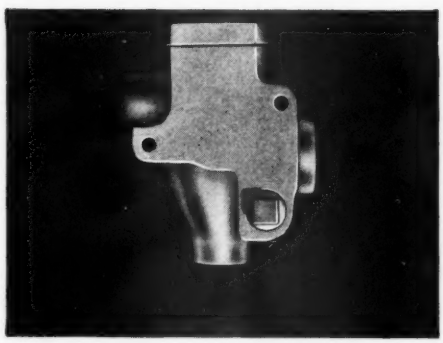
The ACME Model HSJ-4WD Jumbolter can work an area 23′ 10″ wide without moving. The air-articulated arms reach out 9′ in front of the machine. Each arm operates independently and swings 270 degrees.

with

ACME 4 WHEEL DRIVE A.C. or D.C. JUMBOLTER

The versatile ACME Model HSJ-4WD Jumbolter, equipped with tractor-type 4 WHEEL DRIVE, insures minimum turning radius. Left hand and right hand wheels are integrated units. By reversing the wheels on one side while driving forward on the other side the ACME JUMBOLTER will turn in its own approximate diagonal.

This unit, now successfully operating under a variety of conditions, permits bolting in a wide flexible pattern from 8 to 10 feet back of the working face.



An Easy Way to SAVE DOLLARS on Your Air Supply

ACME'S new dust collector shut-off valve stops the operation of the dust collector when the stopers are idle between steel changes, etc. Controlled from the throttle valve of the stoper this simple, mechanical, fully automatic valve synchronizes the operation of the drill and the dust collector. It can be easily installed on your present Le Roi dust collecting system and will substantially lower operator fatigue by eliminating unnecessary dust collector noise. Designated the Model APC-77, the valve is modest in cost.

ACME MACHINERY COMPANY

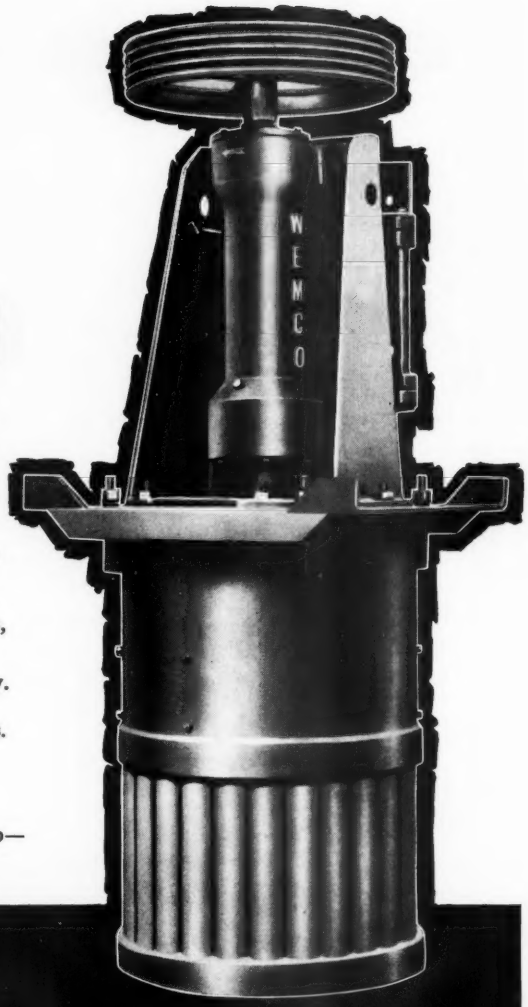
ACME MACHINERY COMPANY

HUNTINGTON, WEST VIRGINIA

WAREHOUSE AND SALES OFFICE
MORGANTOWN, W. VA

REPRESENTATIVES IN PRINCIPAL MINING AREAS

THIS DECISION WILL PAY BONUS PROFITS OF MORE THAN $6,500 EVERY DAY!

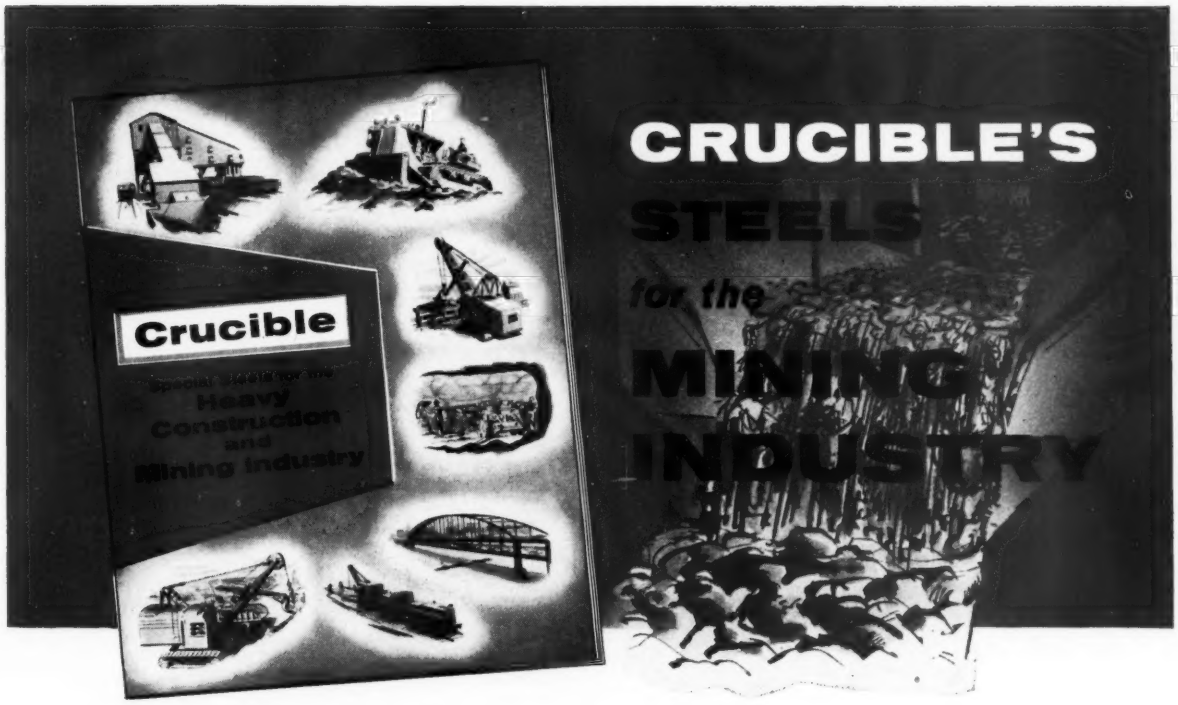


This order and installation of Wemco-Fagergren Flotation Machines by a leading coal producer will result in additional profits of over *$6500 per working day*— and for surprisingly low capital investment. Cost of the total plant addition, including the flotation cells, will be offset in less than four months.

This is another example of how Fags go to work—profitably. Recovery is consistently higher; floor space, maintenance and operating labor, reagent and other requirements are less.

The Wemco-Fagergren record of profit-producing installations tells the story of sound experience. The men of Wemco will be glad to furnish all the facts and discuss why Wemco-Fagergren Flotation will do a better job— where flotation has a place.

WEMCO® *a division of*
Western Machinery Company, 650 Fifth St., San Francisco, Calif.
and throughout the world



This new book tells the story of how and where Crucible's special products solve fabrication and service problems for the mining industry.

Use the coupon and send for your copy now.

Crucible Makes All These . . .

HOLLOW DRILL STEEL

Crucible drill steel is available for any drilling job—both carbon and alloy grades—and in a full range of sizes and shapes.

CARBON

Crusca Hollow Drill Steel is the popular straight-carbon type—standard throughout the world. It's an easy to work with, all-purpose drill steel for jobs not requiring the tougher alloy grades.

ALLOY

CA Double Diamond Alloy Hollow Drill Steel has greater hardness, higher strength than straight-carbon grades. It has superior resistance to fatigue, wear and abrasion.

4E Alloy Drill Steel—affords maximum toughness plus strength and fatigue resistance.

ALLOY STEELS

Bars, billets, rods, plate, sheet, strip, wire, and special shapes in all standard AISI grades and many special analyses for . . .

- car axles
- chutes and conveyors
- shaker screens for rock and ore crushers
- coal cutting and loading machinery
- drill bit bodies
- bits and chisels

TOOL & HIGH SPEED STEELS

All grades, sizes, and types for general tooling, and equipment maintenance.

WELDING RODS

Welding electrodes and hard surfacing welding rods for . . .

- facing screens
- crushing and handling equipment
- shovel teeth, etc.
- general repairs to equipment

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Heat and corrosion resistant stainless in all grades, types, and mill forms for . . .

- vats and receptacles handling corrosive flotation materials
- pump rods
- plates and angles for mancars
- sifting screens

HEAVY DUTY SPRINGS

Hot wound coil springs for crushers, locomotives and cars, vibrating screens and conveying equipment, rock drills, earth moving equipment.

MAGNETS

Alnico permanent magnets for magnetos and impulse generators for . . .

- blasting
- miner's lamps
- safety locks

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Please send me a copy of your new book "Crucible Special Steels for the Heavy Construction and Mining Industry":

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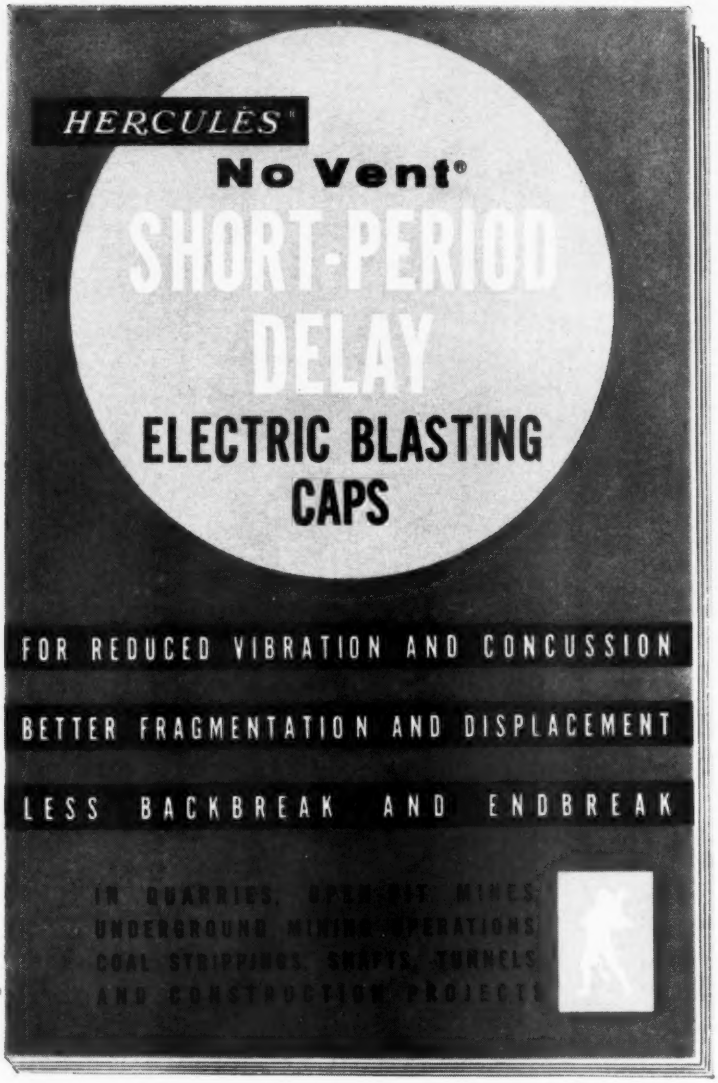

HERE IS YOUR COMPLETE GUIDE TO HERCULES® NO VENT® SHORT-PERIOD DELAY ELECTRIC BLASTING CAPS

Pioneering in explosives techniques and the development of improved materials have long been Hercules' aims. Hercules now offers an extended series of No Vent Short-Period Delay Electric Blasting Caps. They are manufactured to furnish twenty-seven closely timed delay intervals within a period of approximately 2,950 milliseconds.

To help acquaint you with this extended series, Hercules has prepared a 20-page booklet describing the characteristics of the caps, indicated uses, and recommended procedures. If you don't already have a copy of this valuable guide, you'll want to ask your Hercules representative for one. At the same time, he'll be glad to tell you more about how Hercules Blasting Caps can best meet your specific requirements.

XR59-2

Explosives Department

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CATERPILLAR'S **No. 1** PROJECT *

NEW CAT POWER SHIFT TRANSMISSION FOR D9 AND D8 TRACTORS

- **Shifts on-the-go under full load in a split-second!**
- **Changes speed, reverses direction with finger-tip control lever—and no clutching!**
- **Increases production on any application!**

The wraps are off—it's ready. After many years of research and on-the-job testing, Caterpillar now offers a revolutionary new transmission option for D9 and D8 Tractors —*power shift!* Built for heavy-duty tractor service, this new transmission—with an exclusive design—provides production highs never before possible with a track-type tractor. Here's why:

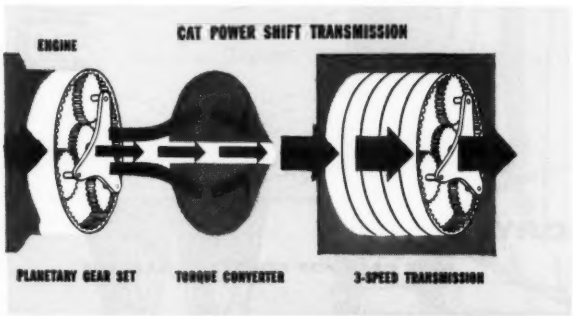
1. It combines for the *first* time the flexibility and anti-stall features of a torque converter with the operating snap of direct drive. And because of its direct drive characteristics, it is more efficient than other power shift designs.

2. With one control lever and no clutching, it reverses direction . . . changes speed . . . smoothly . . . under full load . . . in a fraction of a second.

Talk about productivity—the Cat power shift transmission delivers plenty of power . . . fast . . . in the highest gear possible. And shifting is so easy the operator just naturally gets more work out of the tractor. What's more, he gets it on the toughest, most demanding jobs.

Get the details about the power shift transmission from your Caterpillar Dealer. Ask for a demonstration—see for yourself how it steps up production. Remember, you also have your choice of direct drive or torque converter in the D9 or D8. Whatever the application, Caterpillar has the most productive machine to match the job.

Caterpillar Tractor Co., Peoria, Illinois, U.S.A.



BASIC DESIGN: Total power is transmitted from the engine to a planetary gear arrangement mounted in the engine flywheel. The planetary divides and directs the total power – part goes through a direct drive shaft straight to the transmission and the remainder through a torque converter to the transmission. This division of power retains the best features of both direct and torque converter drive tractors and delivers unexcelled performance on the toughest jobs.

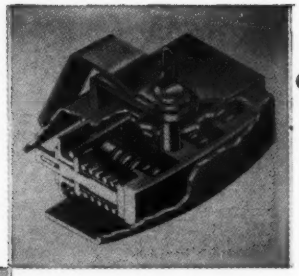
CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

DIESEL ENGINES • TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT

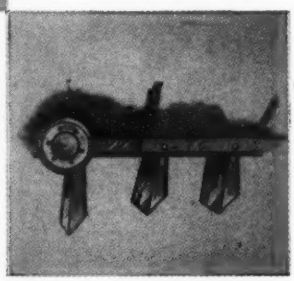
BORN OF RESEARCH
PROVED IN THE FIELD

***CATERPILLAR'S NUMBER ONE PROJECT:** a multimillion-dollar research program—to meet the continuing challenge of the greatest construction era in history with the most productive earthmoving machines ever developed.



acf DOUBLE-ACTION SPRING BUMPER

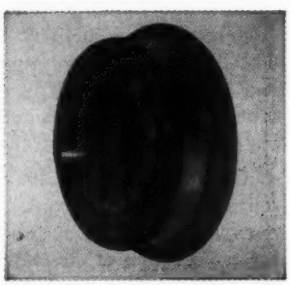
acf WELDED END SILL MEMBER



acf LUBRICATED DROP-BOTTOM DOORS

acf EXTRA-PERFORMANCE COMPONENTS
increase haulage efficiency

acf LOAD SUPPORT WHEELS



Every **acf** Constant Haulage Mine Car—drop-bottom, end dump, or rotary dump—pays off in extra productivity, lower maintenance costs. No matter what type or size your operations need, from 20 to 30 tons or more, there's a service-proved **acf** design that's right for the job. Why not discuss your haulage problems with an experienced **acf** representative. Just contact the nearest **acf** sales office or write department MC-10.

Write for this bulletin describing all types of **acf** *Mine Cars available on request.*

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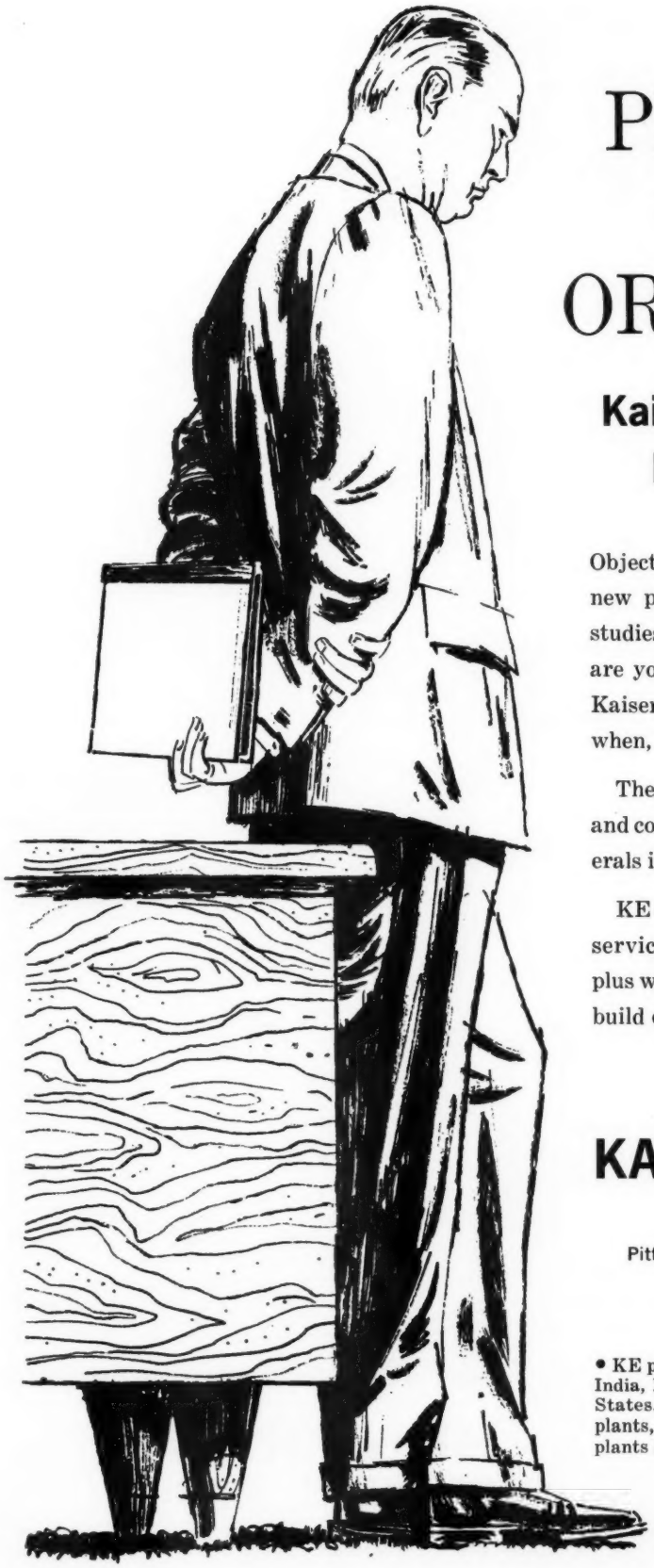

PROCEED, DEFER OR MODIFY?

Kaiser Engineers can help you decide

Objective analysis is vital to sound decision on new plant or expansion projects. Feasibility studies, economic analyses and site evaluations are yours by an outside, impartial firm when Kaiser Engineers is selected to help you decide when, how and where to proceed.

These services are in addition to the design and construction of major facilities for the Minerals industry.

KE offers complete, one-company, integrated service from concept through construction—plus world-wide experience and the ingenuity to build quickly, within budget.

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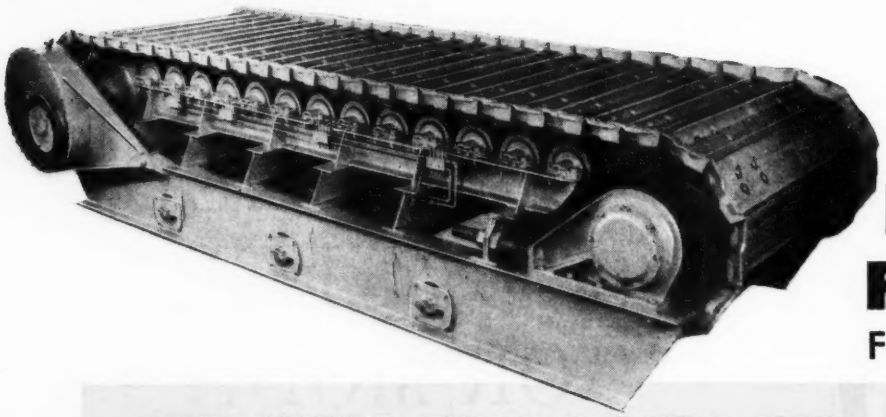
• KE projects include work in Australia, Brazil, Ghana, India, New Zealand, as well as Canada and the United States. Assignments include iron ore concentrating plants, cement plants, bauxite and alumina processing plants and diatomaceous earth facilities.

5458-M



NICO

APRON FEEDERS

FD-4 and FD-8

FOR EXTRA HEAVY DUTY USE

- Uses Mass Produced Standard Crawler Tractor Parts
- Short Pitch, 8" on FD-8, 6-¾" on FD-4, provides more even feed.
- Decks of Cast Manganese or Formed Alloy Steel
- Large Diameter Head and Tail Shafts
- Anti-Friction Self-Aligning Bearings
- Centralized Lubrication Available
- Uses NICO Shaft Mounted Reducer . . .
  Eliminates open gearing and lubrication problems

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BOULDER BOUNCE

won't bruise
this screen!

It's Hendrick Skid-Bar Mounted Wedge Slot Screen. The Skid Bars protect the wedge slot screen from large ore chunks. They also reduce wear caused by abrasive action — assure you of a better dewatering job and longer screen life.

Here's an extra plus: C-12 profile bars on Hendrick Skid-Bar Screens have a thick, parallel head flange which maintains uniform openings throughout the life of the screen.

Hendrick Skid-Bar Screens are fabricated to fit your exact requirements. For further information, write Hendrick today.

HENDRICK
MANUFACTURING COMPANY
62 DUNDAFF STREET, CARBONDALE, PA.

PERFORATED METAL • PERFORATED METAL SCREENS • WEDGE-SLOT SCREENS • HENDRICK WEDGE WIRE SCREENS • ARCHITECTURAL GRILLES • MITCO OPEN STEEL FLOORING — SHUR-SITE TREADS • ARMORGRIDS • HYDRO DEHAZERS • DISTILLATION COLUMN INTERNALS

Questions

We've been asked about the Yieldable Arch

"The Yieldable Arch weighs only 15 lb per foot. Isn't that like sending a boy to do a man's work?"

Strength alone is not the key to the Yieldable Arch's success. It is the "give," or yielding action, which keeps the ground under control as explained in the answer at upper right. If for some reason the joints failed to slide, then the Arch would become, in effect, a rigid set. This is why it is so important that the U-clamp bolts in the joints be tightened only to the proper tightness, and no more.

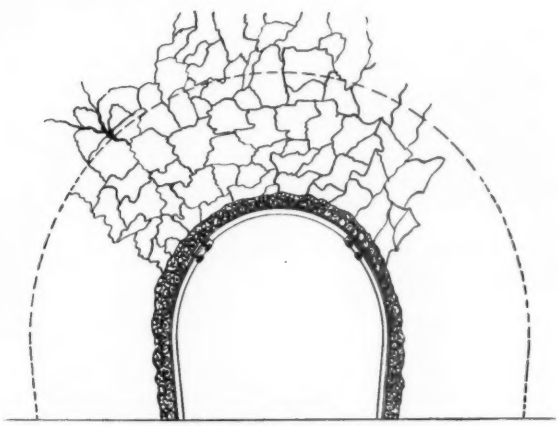
SEND US YOUR QUESTIONS

If you have any questions whatever, about the Yieldable Arch, or Ring, or ground control problems, by all means send them in. We will study your problems carefully, and reply as promptly as possible. Write to Room 1041, at the address below.

"Why does the Yieldable Arch perform better than rigid supports?"

The idea of a yieldable support is to let the ground slowly form its own natural arch. By yielding, the Arch transfers the weight back to the ground. When a natural arch has been formed, it then carries the major share of the load.

Rigid supports cannot return the pressures uniformly to the ground. Thus, no matter how heavy or husky they may be, rigid sets will ultimately fail in moving ground. And, of course, they impose continual maintenance problems.



YIELDABLE ARCHES MUST ABSORB RELAXATION UNTIL NATURAL ARCH IS FORMED.

"Suppose Yieldable sets should deform for some reason. Can they be salvaged?"

Frequently a deformed set can be re-shaped and restored to service. We know of one mine in the West which has had notable success in salvaging arch sets by first heating the segments, then straightening them under a large air hammer.

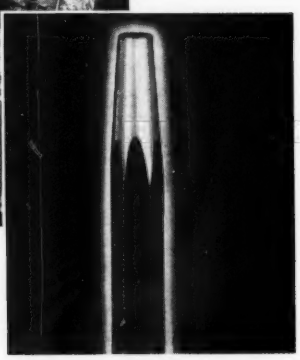
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

VACUJET

Drilling Team cuts roof bolting costs 3 WAYS!



1. VACUJET DUSTLESS STOPER CUTS OPERATING COSTS

Here's a stoper that includes its own built-in dust-removal system—gives you fast, clean drilling without any additional vacuum equipment. An ejector jet built into the drill backhead creates a vacuum that pulls all dust and cuttings down through the hollow drill steel and ejects them under positive pressure to any convenient dust collector. Even a simple canvas bag, as shown above, serves the purpose.

Because of its highly efficient ejection system, the Vacujet Stoper uses 15% less air and provides greater drilling power and speed. It's easier to set up and use, too. There are only two hose connections to the drill—the compressed air line and the dust discharge hose.

If you haven't tried the Vacujet, you don't know how simple and economical dry dustless drilling can be. Ask your I-R engineer for complete information, or send for Bulletin 4195.

2. CARBURIZED DRILL STEEL CUTS ROD COSTS

Ingersoll-Rand *carburized* drill steel is specially treated to provide exactly the right combination of hardness and core toughness to withstand millions of impacts without molecular fatigue. On job after job, these super-steels have outlasted ordinary alloy steel rods by two-to-one! This means less steel to handle—less time out for rod replacement. Rods are easy to recondition, too—simply cut off shank or grind Class B taper for bit end.

3. NEW "one-use" CARSET BITS CUT BIT COSTS

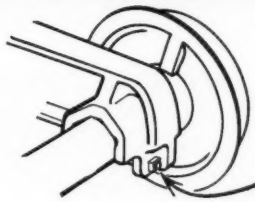
Here's a long-life, heavy-duty tungsten carbide insert bit that can be drilled to destruction *without any resharpening.* One Carset bit will outlast 16 to 20 "one-use" steel bits—at a saving of up to $1.60 per bit cost alone. More important, the time saved changing steel bits is converted into drilling time. On typical applications, "one-use" Carset bits are drilling 235 ft. where steel bits lasted 12½ ft.—and 350 ft. where steel bits were completely used up in 17 feet of drilling. Available in 1½" and 1⅜" sizes, with Class B taper connection. No shims needed.

Ingersoll-Rand

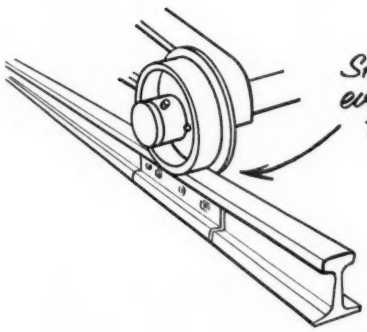
5-970 11 Broadway, New York 4, N. Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

Movement between bolster and side frame is taken on specially designed wear surfaces

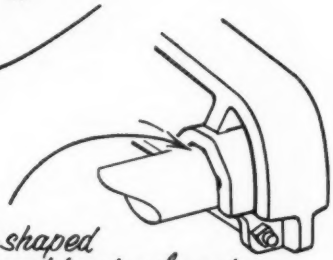


Quick wheel change



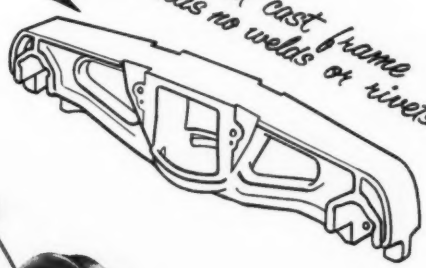
Smoother ride even on rough tracks

Large center bearing for longer life



V-shaped machined axle grips for controlled flexibility and truck alignment

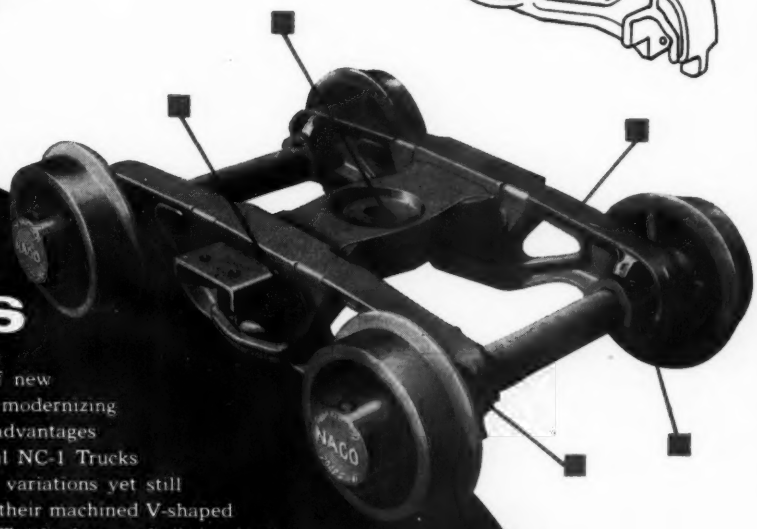
Integral cast frame has no welds or rivets



Check these "plus" features

OF

NATIONAL NC-1 TRUCKS



If you're considering the purchase of new 8-wheel mine cars . . . or if you're thinking of modernizing older cars—*now* is the time to check the advantages of National NC-1 Trucks. National NC-1 Trucks have controlled flexibility for track variations yet still maintain truck alignment through their machined V-shaped axle grips. In addition, NC-1 Trucks have a built-in shock absorbing mechanism.

You get more out of your mine car investment per workshift . . . per day . . . per year. And at the same time you minimize spillage . . . get greater protection for your equipment, track and structures . . . slash maintenance to a new low.

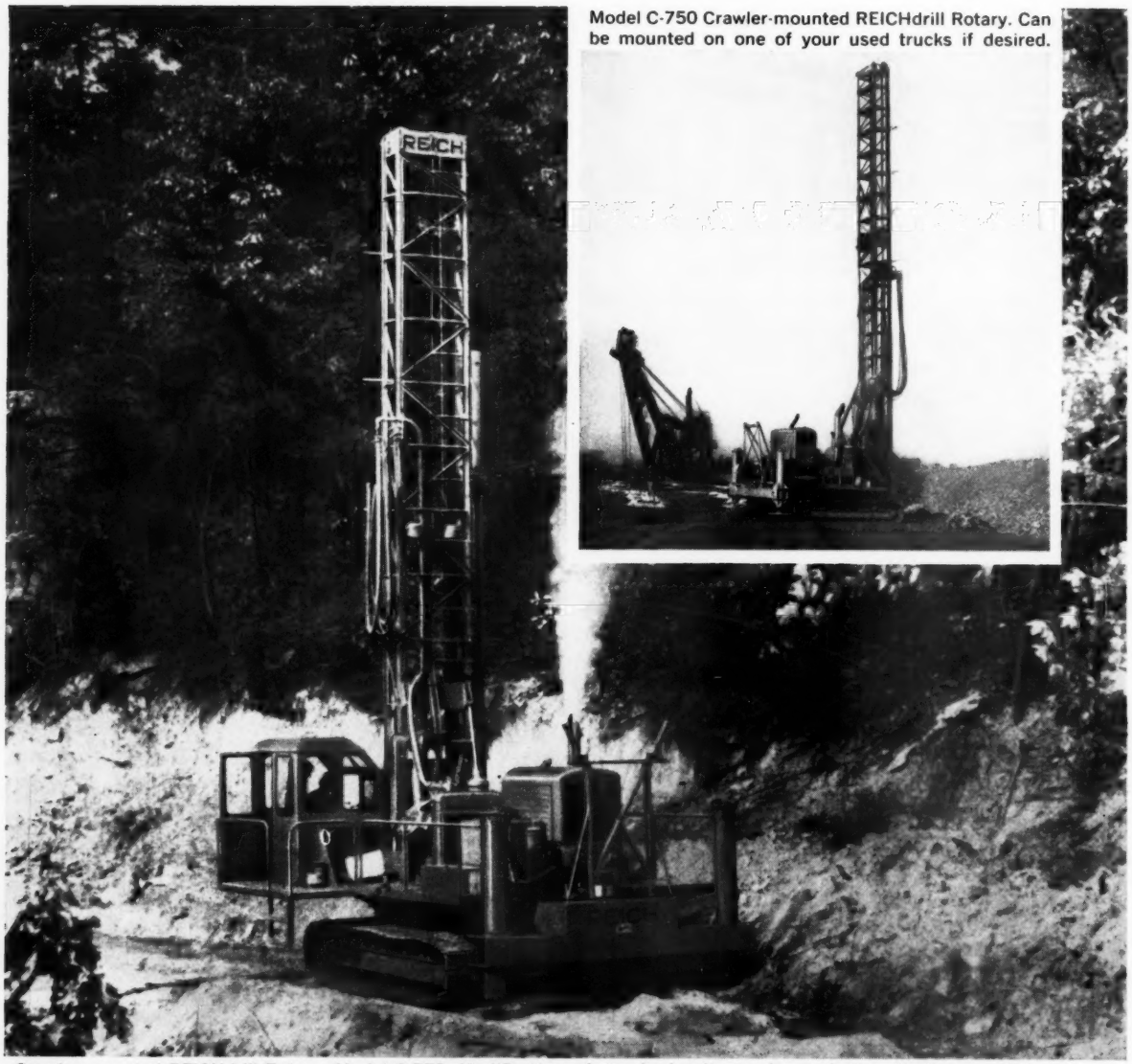
Yes, *now* is the time to check National NC-1 Trucks—they make sense for 8-wheel mine cars . . . *make dollars for operators*, too.

- WILLISON AUTOMATIC COUPLERS
- RUBBER CUSHIONED UNITS
- NC-1 CAR TRUCKS • NACO STEEL WHEELS
- NACO STEEL LINKS & SWIVEL HITCHINGS

AA-5077

NATIONAL MALLEABLE and STEEL CASTINGS COMPANY

Established 1868 — *Cleveland 6, Ohio*



Model C-750 Crawler-mounted REICHdrill Rotary. Can be mounted on one of your used trucks if desired.

Crawler-mounted REICHdrill Rotary, Model C-750. Modification of standard units can be made to suit given conditions.

IN THE COAL FIELDS
REICHdrills GIVE YOU MUCH MORE HOLE PER DAY

And here are 4 rugged reasons why:

1. Variable rotation speed gives you exactly the right RPM for any material, rock to rubble.

2. Minimum of control levers for all operations means fast, easy handling by one man.

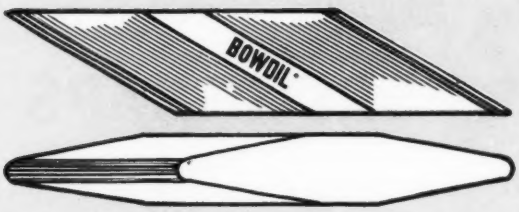
3. All controls actuated by smooth hydraulic power, saving operator time and tiring.

4. Extra heavy-duty construction on all component parts, including pumps, gears and frame means rig can take long, high speed duty without costly maintenance. Plus other field-proven features like hydraulic stem loader and down-the-hole hammer.

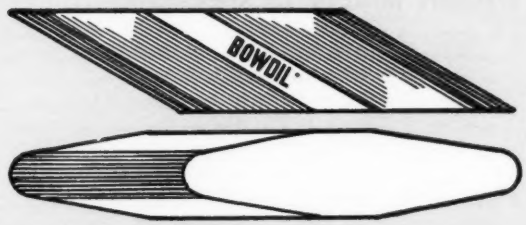
Units can be supplied truck or crawler-mounted to suit operating conditions. Holes up to 12″ diam. Down pressure to 75,000 lbs. Write for detailed information on REICHdrills.

REICHdrill ***Division: Chicago Pneumatic Tool Company***

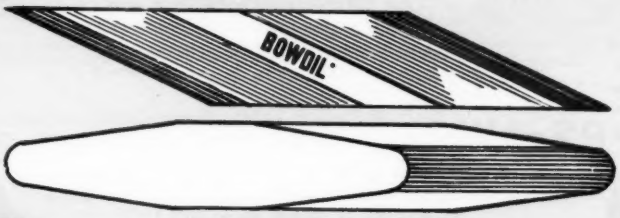
1439 ASH STREET, TERRE HAUTE, INDIANA



Series 1-1 **REGULAR DIAMOND BIT, designed for use where cutting conditions are not too severe. Saves power, produces coarse cuttings. 1-1 is MEDIUM Temper, 1-1N1 TOUGH, 1-1N2 HARD.**



Series 1-2 **HEAVY DIAMOND BIT is especially designed for severe cutting conditions (Iron Pyrites and Rock). 1-2 is MEDIUM Temper, 1-2N1 TOUGH, 1-2N2 HARD.**

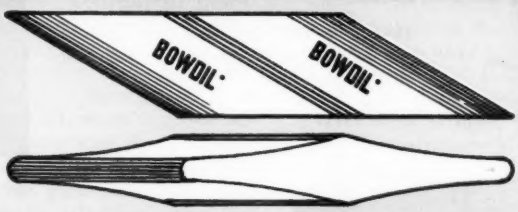


Series 1-6 **LONGWALL BIT is especially designed with a long cutting point for Longwall work. 1-6 is MEDIUM Temper, 1-6N1 TOUGH, 1-6N2 HARD.**

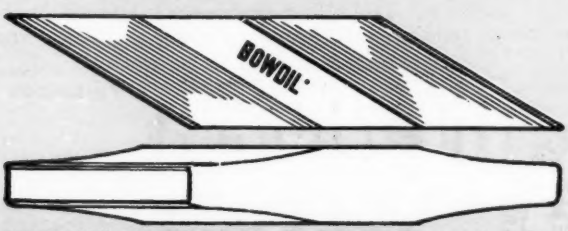
There's a BOWDIL® Bit for every cutting need!

These various types are designed for specific requirements, are made from special alloy steels and are heat treated to three different tempers as listed. Through many years of research on actual conditions in the field, these styles, shapes and hardnesses of Bowdil Bits consistently prove the most popular. We are happy to offer our experience and recommendation for your individual need.

TO HELP YOU RE-ORDER, PLACE YOUR TYPE BIT ON THESE ACTUAL SIZE DRAWINGS



Series 1-11 **REGULAR CONCAVE BIT is designed for the maximum in power savings. Due to the concave shape, side clearance is automatically maintained as the face is worn away, resulting in a more uniform power consumption over the full life of the bit. No. 1-11 is MEDIUM Temper, 1-11N1 TOUGH, 1-11N2 HARD.**



Series 1-29 **HEAVY DUTY CONCAVE BIT has the design features and similar cutting advantages of the Regular Concave, but is made heavier for very severe service. No. 1-29 is MEDIUM Temper, 1-29N1 TOUGH, 1-29N2 HARD.**

ORDER BY NUMBER!

THE BOWDIL CO., CANTON, OHIO

Gentlemen: Rush us

_____ NO. _____ BITS
(Quantity)

Name _____

Address _____

City _____ State _____

THE BOWDIL COMPANY

Boylan Ave. S. E. Phone GLendale 6-7176
CANTON, OHIO

Here are the INSIDE REASONS why

DENVER SRL PUMPS

- wear up to 15 times longer...
- save up to 50% in horsepower!

DENVER SRL PUMPS
cost less, last longer...

...*because* casing liners and runners are tough rubber, pressure-molded to steel for longest wear, lowest maintenance!

● RUBBER MOLDED TO STEEL

Runners and casing liners are tough, abrasion-resistant rubber pressure-molded to close tolerances over steel skeletons and backing plates. This gives necessary rigidity and provides precision fit of parts for high pumping efficiency. Rubber covered parts last up to 15 times longer than the best hard iron or alloy steel. Means fewer shutdowns...lower maintenance.

● HIGH EFFICIENCY...LOW HORSEPOWER

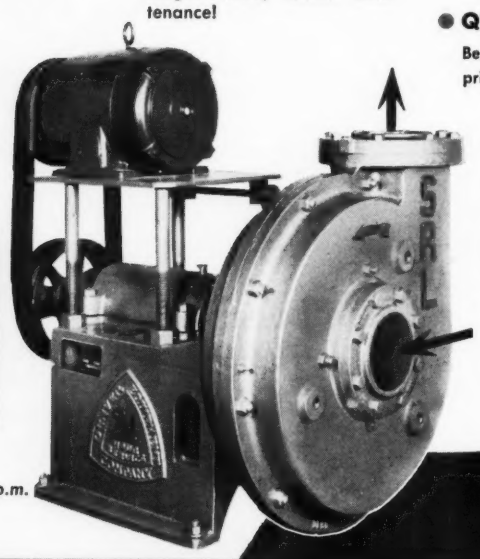
Precision fit of parts and hydraulic efficiency result in savings as high as 50% in horsepower over other sand and slurry pumps.

● SIMPLE CONSTRUCTION

DENVER SRL Pumps have few parts, rugged design. Available in either sealing water type or with mechanical shaft seals, open or closed runner. Also available with alloy metal runners or in special construction for corrosive solutions.

● QUANTITY PRODUCTION MEANS LOW COST

Because of quantity production, DENVER SRL Pumps are now priced low—so low that no operator can afford any pump service less than that of DENVER SRL Pumps.

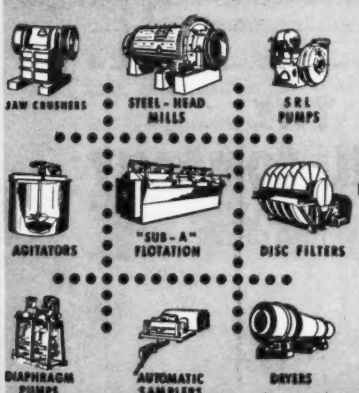


Capacity to 3000 g.p.m.

PARTS COST LESS, TOO!

Parts cost less and last longer for even greater economy. All DENVER Pump parts are carried in stock for quick delivery. Fast replacement parts service reduces your inventory requirements.

Learn how DENVER SRL Pumps can save money for you. Write for recommendations and prices!



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Why pivot-steer hauler

cuts equipment downtime... boosts pit output... lowers handling costs...

Rugged, simplified construction is one big reason why speedy LeTourneau-Westinghouse Tournapull® Rear-Dumps keep working efficiently day after day... year after year... to help pit owners cut costs. Notice that on this machine there are no springs, no tie rods, no hose and pipe lines, no frame, no long drive-shaft to require maintenance and repair.

In place of a foundation frame and body sub-frame, Tournapull prime-mover and trail-unit are hitched together by means of a high horizontal yoke. Yoke pivots horizontally on kingpin at front... then extends back along side of bowl, where it pivots vertically just above and ahead of rear wheels. This unique vertical and horizontal kingpin arrangement also provides an easy oscillating action that eliminates most twisting, tilting strains ...permits higher working speeds on uneven ground to boost pit output.

Resists heaviest loading jolts

Shovel operator does not have to take it slow and easy when loading heavy materials. L-W Rear-Dump bowl is all steel — no wood fillers. Triple-layer floor is lined with heat-treated tool-steel strips, welded to solid billets laid over heavy steel plate. Sloping sides deflect load shock, quickly cushion floor area with layer of material to minimize rock damage.

Tire, clutch, transmission wear reduced

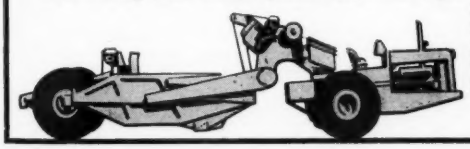
Costly wear on tires, clutch, and transmission caused by spinning wheels in slippery or loose footing, is minimized with Tournapull Rear-Dump. When either powered wheel begins to spin, unit's exclusive L-W power-transfer differential automatically diverts up to 80% of power to drive wheel on firmest footing. Also, electric 90° pivot-turn through geared kingpin, lets operator "walk" prime-mover out of mud or loose sand. Dumping action can also be used to "hump" empty hauler off a soft bank.

Features like these — plus full 90° turns, efficient electric-controls, fast, clean dump, giant air brakes, excellent visibility — add up to high production and low costs. Let us show you a LeTourneau-Westinghouse Tournapull Rear-Dump in action. Available in 3 sizes: 11, 22, and 35 tons.

R-1892-MQ-1

Bonus interchangeability feature

For less than ¼ the cost of an L-W Tournapull prime-mover with Rear-Dump, you can get an easy-loading L-W scraper to interchange with original Rear-Dump trail-unit. Change-over — using same 2-wheel prime-mover — takes just a few hours. Use scraper to lower dirtmoving costs on stripping operations, haul-road or drainage construction, and for exploratory mining. Other trail-units to increase prime-mover's usefulness also available.



LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

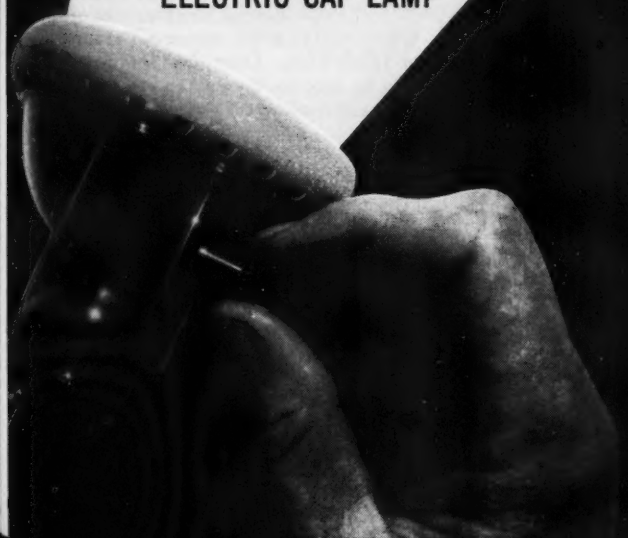
IN MINERS ELECTRIC CAP LAMPS—

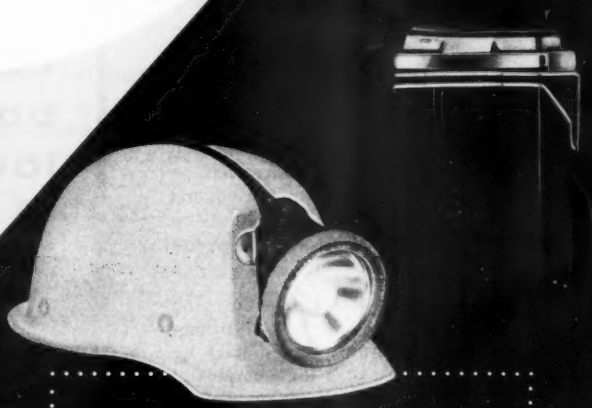
The RIGHT SPOT is the WHEAT SPOT every time!

Every time you turn the switch on the Wheat National, you get a perfect spot. The exact, bright-centered spot you want, made to suit your needs, from either filament! Only WHEAT gives you this most-wanted feature.

Nothing could be simpler—nothing could be better. Let us demonstrate this and the many other reasons why, today more than ever, THE TREND IS TO WHEAT.

The WHEAT National MODEL ELECTRIC CAP LAMP





National Mine Service Company

Koppers Building Pittsburgh 19, Pa.

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NATIONAL MINE SERVICE (CANADA) LIMITED
Elliot Lake, Ontario

YES ☐ or NO ☐ ?

Photo shows how a regular program of maintenance with grader can keep haul routes smoother . . . can help you boost the number of hauler round-trips. Grader is raising the practical speed-limitation of this road *at least 5 mph*. How many extra tons would that produce at your digging . . . daily? . . . yearly?

Are you getting top possible output? Is your cost-per-ton as low as can be?

Check your answers to the following questions. Then consider how the services of additional, fast-working graders — or more extensive use of present machines — can step-up output . . . cut operating costs . . . boost net profit.

Yes ☐ No ☐ Do you blade haul roads regularly? Smooth-graded roads speed hauling, for more trips per day . . . cut hauler downtime, reduce tire wear, make roads safer.

Yes ☐ No ☐ Do you keep pit floors clean? Do you clean-up quickly after blasting? A regular program of clean-up pays-off. Maintenance of wide, clear traffic-ways makes all areas quickly accessible by shortest route. It speeds loading and hauling . . . prevents accidents . . . reduces wear on tires and machines. Regular clean-up, and good drainage prevents dirt and refuse from weathering into ore, minerals, or coal below the floor.

Yes ☐ No ☐ Do you practice good housekeeping around plant? A clean plant area speeds equipment traffic, reduces dust, increases efficiency. It pays to keep roads, runways, and working areas neat, clean, and workable at all times by leveling or removing fall-off from heaped trucks . . . spillage from around crushers, grizzlies, conveyors, trestles, etc.

Yes ☐ No ☐ Do you keep stockpile toes pushed in? Scattered piles limit working space, tend to down-grade material, increase loading costs. A regular program to roll-back thinly-spread toes costs little, pays-off big in time and material saved.

Yes ☐ No ☐ Do you keep dumps smooth and level? You speed hauling and dumping, cut costs, when dumps are smooth, level, dry. A grader can handle dump maintenance and drainage quickly. Its offset blade reaches far out beyond wheels to safely cast material clear over edge. And as it travels to-and-from the dump, grader smooths your haul road.

Yes ☐ No ☐ Do you promptly clean washed-down dirt off benches? Every rain may wash dirt onto upper benches . . . may lower the quality of rock and ore below. Prompt grader service halts "wash," provides planned drainage, piles refuse for easy removal by scraper or loader and truck.

Yes ☐ No ☐ Do you put a grader on your exploration or development "teams"? A modern grader can build a smooth well-drained roadway in a matter of hours . . . can speed exploration work by maintaining good access roads for quick transport of men, supplies, and equipment.

Yes ☐ No ☐ Do you keep ditches clear . . . drainage open? Just a few hours of grader work per week on ditches along roads, in pit, and elsewhere, will keep drainage open . . . assure fast run-off. A planned drainage system and a regular maintenance program prevents seepage of dirty water into pit bed . . . minimizes break-up of haul roads . . . keeps haulers and shovels operating on dry footing.

Before you buy any grader, be sure to get complete information about fast, powerful, L-W Adams† Model graders. These LeTourneau-Westinghouse machines are offered in weight, power, and price-ranges that will exactly fit your needs. Seven models: 190, 160, 145, 123, 115, 80, 67 hp. Choice of GM or Cummins engine on 6 larger models. Write for details.*

*With torque converter †Trademark G-1872-MQ-1

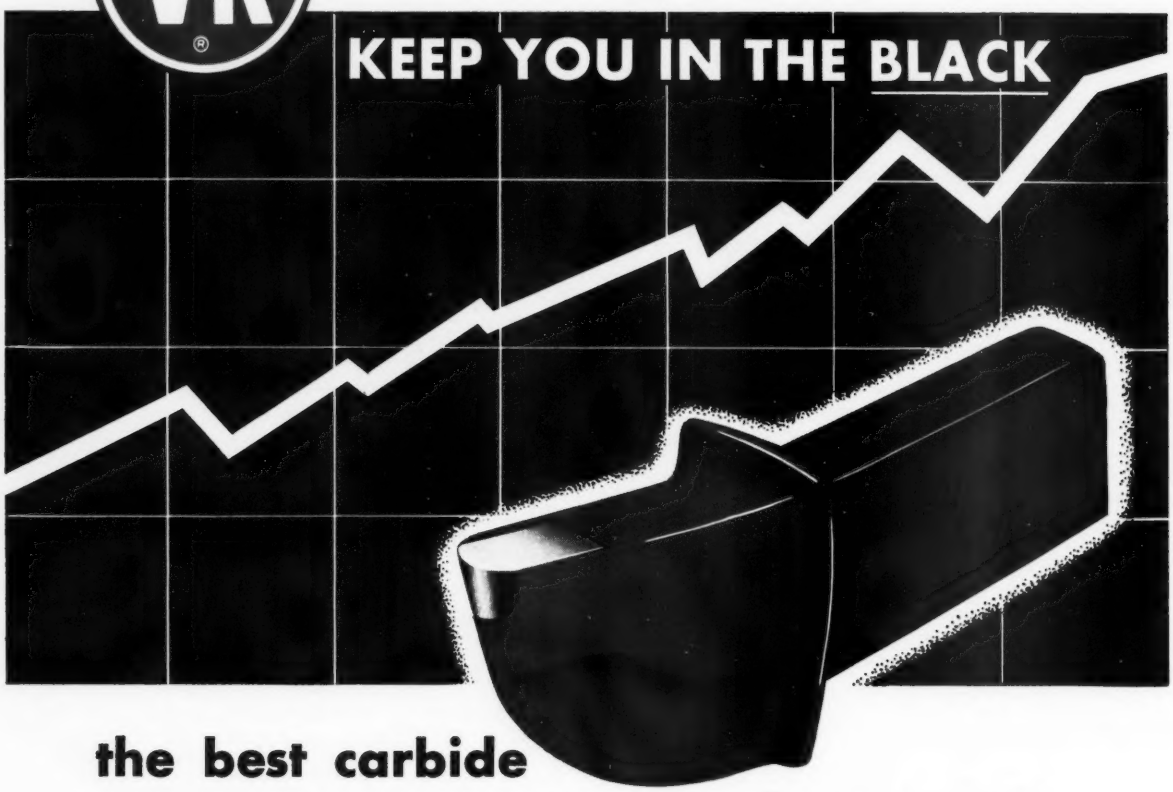
LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

V-R RED BITS

KEEP YOU IN THE BLACK



the best carbide means more tonnage . . . lower costs

V-R quality carbide . . . plus engineering knowledge . . . plus complete V-R service add up to more tonnage per machine and lower cost per ton.

29 years of carbide research and manufacturing experience . . . controlling quality from the ore to the finished product . . . have produced the faster cutting carbides used in V-R Red Bits.

Put these rugged bits to work in your mechanized mining equipment for continuous trouble-free production.

Send for new Catalog VR-488 for complete details.

The best mining bits are manufactured at V-R . . . beginning with the manufacture of the carbide.

Vascoloy-Ramet corporation

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

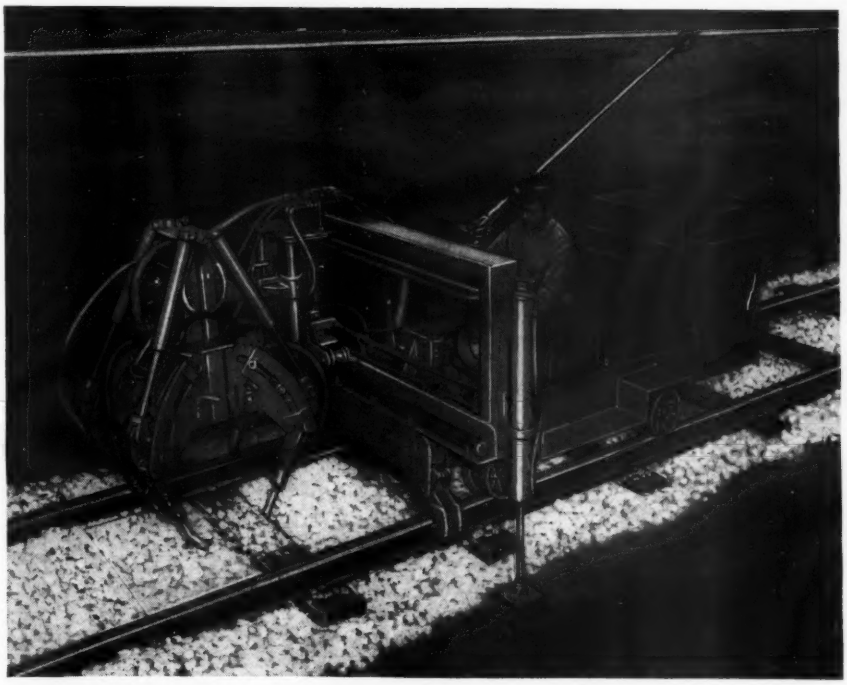
M-756

882 Market Street • Waukegan, Illinois

A Fletcher MINE TRACK TAMPER

CAN CUT LABOR COSTS 90%

on Your Track Tamping and Leveling Work



A New Cost-Cutting Machine From Industry's Largest Manufacturer of Roof Bolting Drills!

Higher speeds, bigger mine cars, heavier locomotives all demand better track — *and better maintenance* — for economical main-line haulage. The FLETCHER Track Tamper can produce the level, solid trackage you need—*and pay for itself in an unbelievably short time* by allowing a two-man crew to do SIX TIMES the work a five-man crew used to do.

With built-in hydraulic track clamps and leveling jacks, exact grade or bank can be established. The sliding tamper head with four special impact tools then solidifies the ballast under the ties with a combination of sharp blows and orbital thrust. *In sixty seconds one tie is done and the machine moves on to the next.*

Write or call for literature on how to save money with the new FLETCHER Mine Track Tamper.

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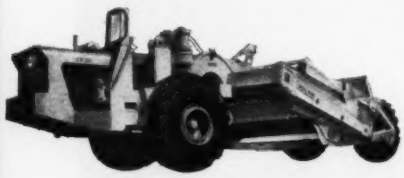
YARDS ON

MODEL CW-220
20.0 cu. yds. STRUCK
27.0 cu. yds. HEAPED
INTERCHANGEABLE WITH MODEL CWD-221 REAR DUMP UNIT

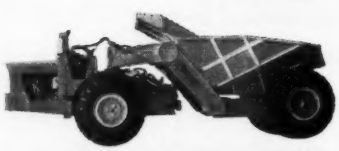


MODEL CW-215
15.0 cu. yds. STRUCK
21.0 cu. yds. HEAPED
INTERCHANGEABLE WITH MODEL CWD-214 REAR DUMP UNIT

MODEL CW-27
7.0 cu. yds. STRUCK
10.0 cu. yds. HEAPED

MODEL CW-226
26.0 cu. yds. STRUCK
36.0 cu. yds. HEAPED

MODEL CW-320
20.0 cu. yds. STRUCK
27.0 cu. yds. HEAPED
INTERCHANGEABLE WITH MODEL CWD-321 REAR DUMP UNIT

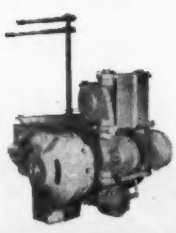


MODEL CWD-221
21.0 cu. yds. STRUCK
31.0 cu. yds. HEAPED
35-TON LOAD CAPACITY
INTERCHANGEABLE WITH MODELS:-CW-220

INTERCHANGEABLE WITH MODEL CW-320 SCRAPER UNIT

MODEL CWD-321
21.0 cu. yds. STRUCK
31.0 cu. yds. HEAPED
35-TON LOAD CAPACITY

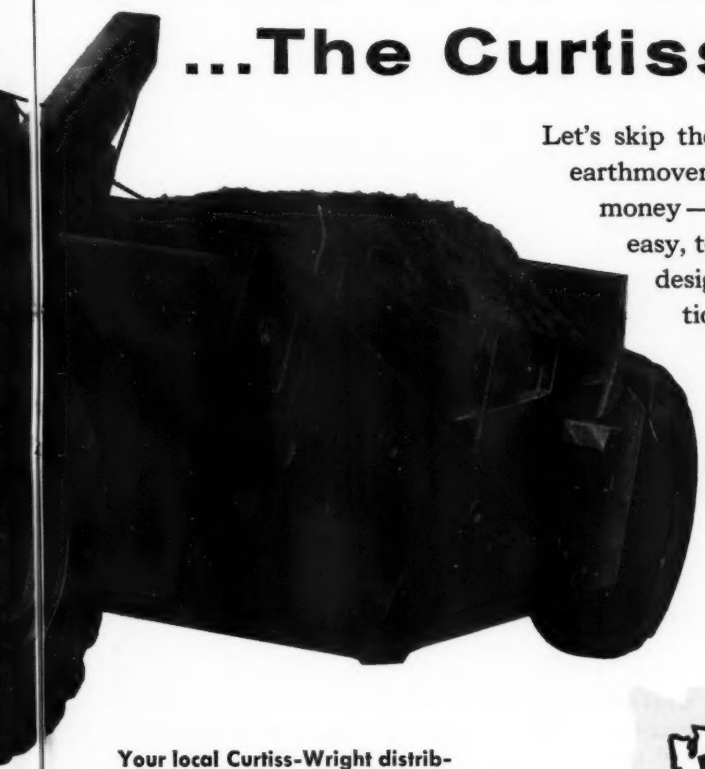
MODEL CWT-20
20.0 cu. yds. STRUCK
27.0 cu. yds. HEAPED



CABLE CONTROLS
for standard tractors in every horsepower range

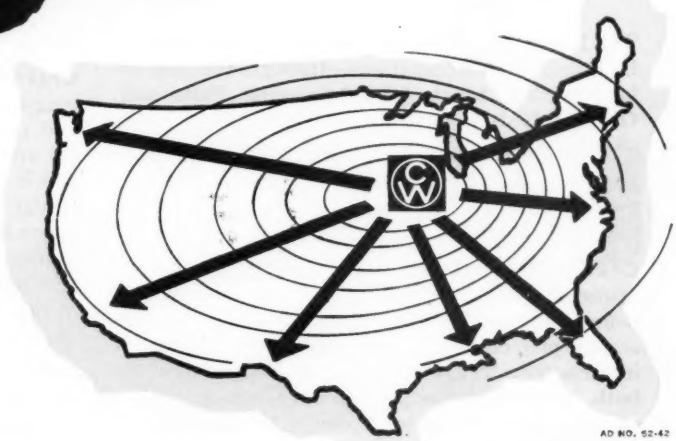
AHEAD

OPEN PIT EXCAVATION ...The Curtiss-Wright Line



Let's skip the details and get down to basic facts about earthmovers. If you move more dirt, you make more money — it's as simple as that . . . and just about as easy, too, with the modern Curtiss-Wright line. C-W design features for high performance, easy operation and low maintenance put you yards ahead in production — dollars ahead in profit on any earthmoving job. Call your Curtiss-Wright distributor for complete information and specs on the machine performance matched to your job requirements.

Your local Curtiss-Wright distributor is part of a nationwide sales, parts and service network devoted to making Curtiss-Wright users the most satisfied in the industry. You can depend on him for the most efficient, most cooperative service that it is possible to provide.



AD NO. 52-42

SOUTH BEND DIVISION, CURTISS-WRIGHT CORPORATION • SOUTH BEND, INDIANA

SOUTH BEND DIVISION
CURTISS-WRIGHT CORPORATION
SOUTH BEND, INDIANA

Increase grinding mill efficiency... with CF&I Grinding Media

The Image of CF&I helps assure increased output in grinding mill operations—through the use of long-wearing, tough CF&I Grinding Balls and Grinding Rods.

The special analysis steels used in these products give an ideal balance between hardness and toughness—thus affording optimum grinding ability plus maximum wearability.

CF&I GRINDING BALLS are hot-forged and carefully inspected throughout production and immediately before shipment to assure that they are free of surface pits, circumferential ridges or other surface imperfections. They have excellent resistance to both abrasion and impact, and operate economically in either high or low speed mills. Available in diameters from ¾" to 5".

CF&I GRINDING RODS are hot-rolled of a special long-wearing steel which minimizes both bending and premature breakage. All rod ends are square cut and rods are of proper length to fit the mill in which they will operate. All rods are machine straightened to assure maximum line contact between the rods for the full length of the mill. These properties help facilitate rod line-up in the mill and eliminate tangling of the charge. Available in ½" increment sizes from 1½" to 4" in diameter and in various lengths.

For complete information and service on all CF&I Mining Products, contact the nearest CF&I sales representative.

OTHER CF&I STEEL PRODUCTS FOR THE MINING INDUSTRY
CF&I Mine Rail and Accessories • CF&I Rock Bolts and Realock Metallic Fabric
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THE COLORADO FUEL AND IRON CORPORATION

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COMPACT, NEW THOR AIR HOIST—
raise, lower, stop loads with one control

Now Thor makes material handling on-the-job easier and quicker with the introduction of this simple, compact utility air hoist. Easily portable, the hoist can be mounted on vehicles or set up at the job site. Completely foolproof, easy operation. With throttle valve alone a load can be raised, stopped, held, lowered at any speed desired; stopped or slowed while being lowered or raised again at varying speeds. Your Thor "Red Tool" distributor will demonstrate.

MODEL 1500
UTILITY AIR HOIST

For all types of material handling. Reversible motor. 4-way simple one-lever control. Integral or remote operation.

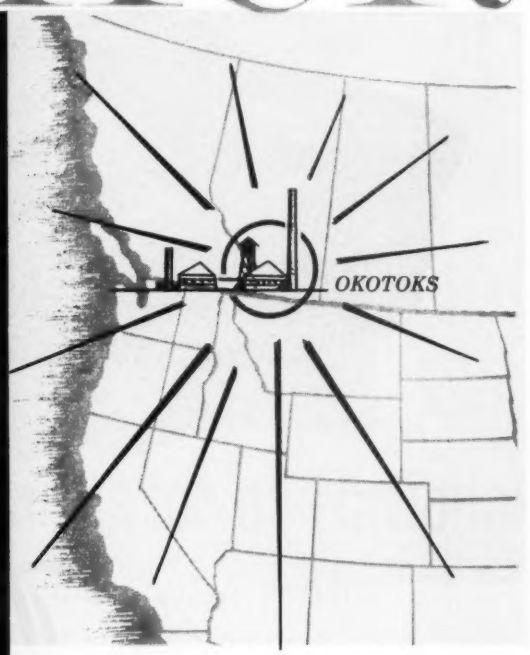
Thor
PORTABLE POWER
TOOLS

THOR POWER TOOL COMPANY, AURORA, ILLINOIS

Branches in all principal cities

SULPHUR

Spotlighting the new TGS Recovery Plant at OKOTOKS



OKOTOKS marks another step in the steadily broadening service being developed by TGS for industries in the States and Canada. Production from OKOTOKS, sitting on top of the vast "sour gas" field a few miles south of Calgary, Alberta, will add a significant tonnage to the supplies of Sulphur already available through TGS to the expanding industries in the Pacific Northwest. OKOTOKS is set up to make shipments of Sulphur in solid or molten form.

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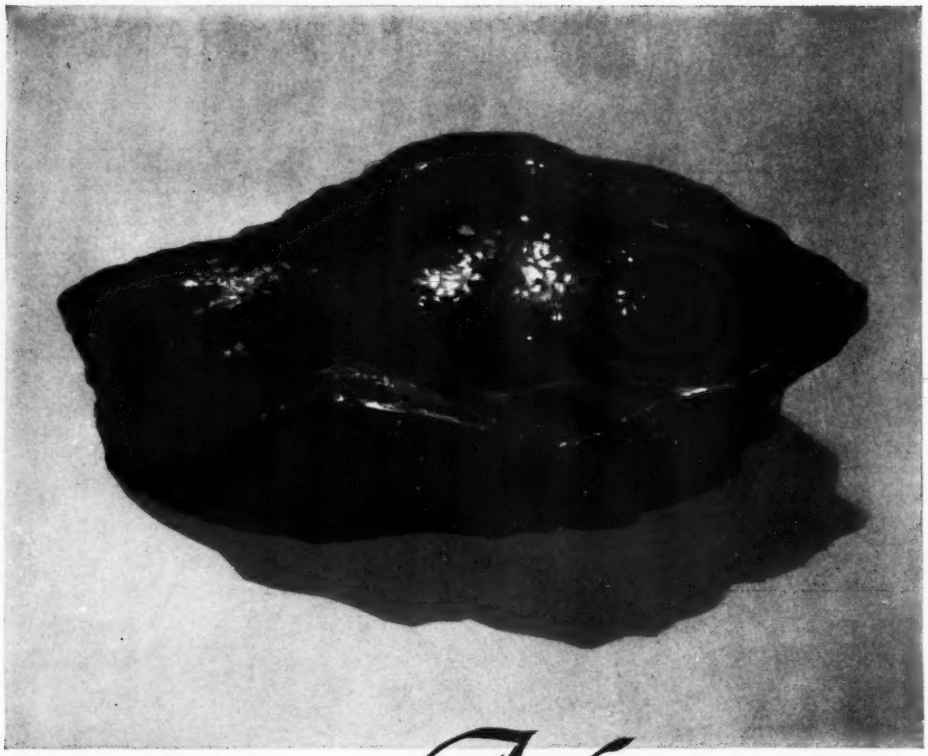
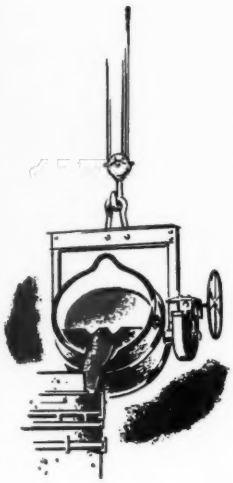




Hematite

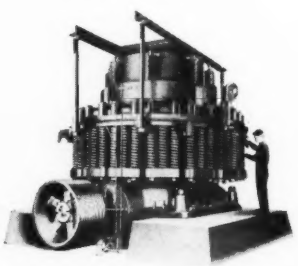
Fe_2O_3

...life blood of Industry

Derived from the Greek word meaning blood, or blood-like, Hematite was so named because of the reddish hue found in most of its varieties. This important mineral has indeed provided "life blood" for the iron and steel sinews of industry. For many decades, Hematite—the basic ingredient which feeds the blast furnaces of the world—has been one of the most important minerals of civilization.

Symons Cone Crushers, with their great capacity for finely crushed material at low cost, have been an important factor in the efficient reduction of the Hematite, as well as the Magnetite and Taconite iron ores throughout the world, and have established outstanding production records in keeping pace with industry's insatiable demands.

NORDBERG MFG. CO., Milwaukee 1, Wisconsin



SYMONS CONE CRUSHERS
. . . The machines that revolutionized crushing practice . . . **are built in a wide range of sizes, for capacities to over 900 tons per hour. Write for descriptive literature.**

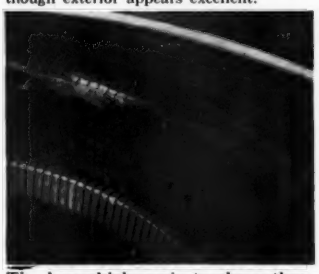
We look inside your commutator at National

...The Specialists in electric coils/repair service

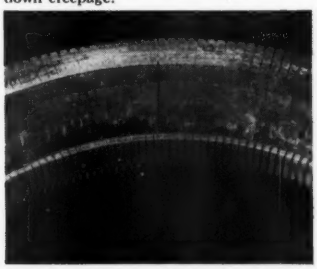
AND HERE'S WHAT WE OFTEN FIND!

Enlarged view of a dielectric puncture of a mica vee ring at the lower end of the copper bar. This is an example of interior commutator faults which may be present though exterior appears excellent.

Shifted or squirted mica at the apex of the 3° and 30° cone surfaces of a mica vee ring. The black lines on the 3° surface were made by bar-to-bar voltage breakdown creepage.



The bar which projects above those adjacent has been locally overheated under a brush and softened.



A mica segment on the front end of the commutator has started to work out radially and will eventually result in a bar-to-bar short circuit.

When you send D-C machines to National for rewinding or rebuilding, the commutator gets a close inspection and test. But we've found from experience that a commutator that looks excellent on the surface may be in deep trouble inside... with mica cooked, varnish burned, loose copper, or imminent short circuits.

So when we are suspicious of the commutator we remove and open it for a close interior inspection. It's another added assurance that machines rebuilt by National will give you long, dependable service.

For more information, call National's Columbus plant... HUdson 8-1151. Or call the nearest National field engineer.

National Electric Coil

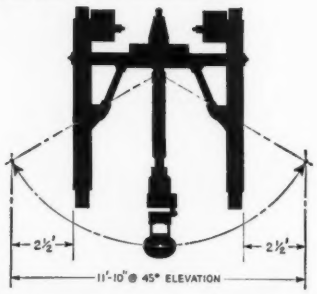
McGRAW EDISON

DIVISION OF McGRAW-EDISON COMPANY

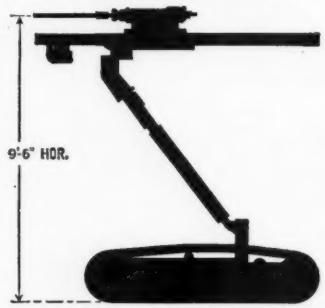
COLUMBUS 16, OHIO

ELECTRICAL ENGINEERS • MANUFACTURERS OF ELECTRICAL COILS, INSULATION, LIFTING MAGNETS • REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

MORE SWING

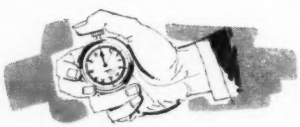


...MORE REACH



...MORE FOOTAGE

with Gardner-Denver Swing-Boom "Air-Trac"®



TIME TO TALK TIME-SAVING

Gardner-Denver believes there's no substitute for men—it has been our philosophy of growth for 100 years. Your Gardner-Denver construction equipment specialist has helped many uncover ways to speed the pace . . . lower drilling costs. He's a good man to know. Get in touch with him soon.

Swings 11'10" . . . 2½' over both tracks Now drill more hole from one position . . . drill over a ledge from either side. Feed swings 11'10" at 45° elevation . . . moves to 2½' outside of each track with balanced stability.

Reaches to 9'6" height—for horizontal drilling Get better spacing of horizontal holes . . . reach to 9'6" for high breast holes.

Moves quickly . . . safely "Air Trac" is self-equalizing, self-stabilizing, with hydraulic track oscillation. Moves easily, safely over roughest terrain. Designed with an unusually low center of gravity for maximum stability. Long tracks and powerful crawler motors provide plenty of traction. "Air Trac" will pull its own compressor. Tracks available with rubber or steel pads.

Saves time . . . steps All controls conveniently located. Drilling and positioning controls grouped at the front of rig to save steps, setup and drilling time.

Pulls tight steel Powerful Gardner-Denver 5-cylinder radial air motor enables your driller to put the right pressure on the bit in all drilling situations . . . provides necessary pulling power to bring tight steel out of the hole.

Maintains hole alignment Easily handles in-line drilling . . . drilling in fitchery or fractured formations. Creep-free hydraulic boom keeps drill in position . . . track locks keep rig firmly in place in difficult drilling spots.

Drills fast, clean hole Gardner-Denver's line of powerful rock drills is most complete—six hard-hitting models to choose from.

Write for bulletin.

GARDNER-DENVER Since 1859 — 1959 YEARS

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER-DENVER

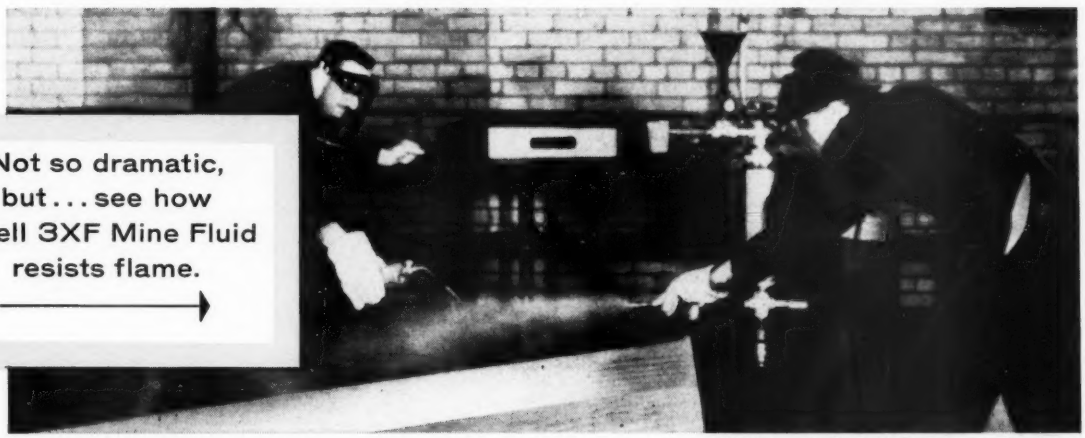
Gardner-Denver Company, Quincy, Illinois

In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

Export Division: 233 Broadway, New York 7, N. Y.

Dramatic photo shows flammability of conventional hydraulic oil. →

Flame tests prove fire-resistant properties of this hydraulic fluid



Not so dramatic, but... see how Shell 3XF Mine Fluid resists flame. →

Photos: courtesy U. S. Bureau of Mines

First low-cost fire-resistant mine fluid!

SHELL 3XF MINE FLUID HAS BEEN TESTED BY U.S. BUREAU OF MINES AND IS NOW IN USE

Now—for the first time in mining history—an inexpensive, fire-resistant emulsion-type hydraulic fluid is available for mine equipment use—3XF* Mine Fluid.

No major modification of equipment is necessary—Shell 3XF is a direct replacement for ordinary hydraulic oils now in service.

Convenient to use—Shell 3XF Mine Fluid, furnished as a concentrate, is mixed with water to prepare the emulsion *at the mine location.*

Proof of its fire-resistant qualities—In addition to recommending the use of fire-resistant hydraulic fluids in mining machinery, the Bureau of Mines has evaluated 3XF Mine Fluid using test methods that determine fire-resistant properties, and accepted it for mine evaluation, pending the establishment of a Bureau approval schedule.

For complete information on 3XF Mine Fluid, write or call Shell Oil Company, 50 West 50th Street, New York 20, New York, or 100 Bush Street, San Francisco 6, California. In Canada: Shell Oil Company of Canada, Limited, 505 University Avenue, Toronto 2, Ontario.

*Trademark

SHELL 3XF MINE FLUID

SHELL

EUCLID

PRESENTS...

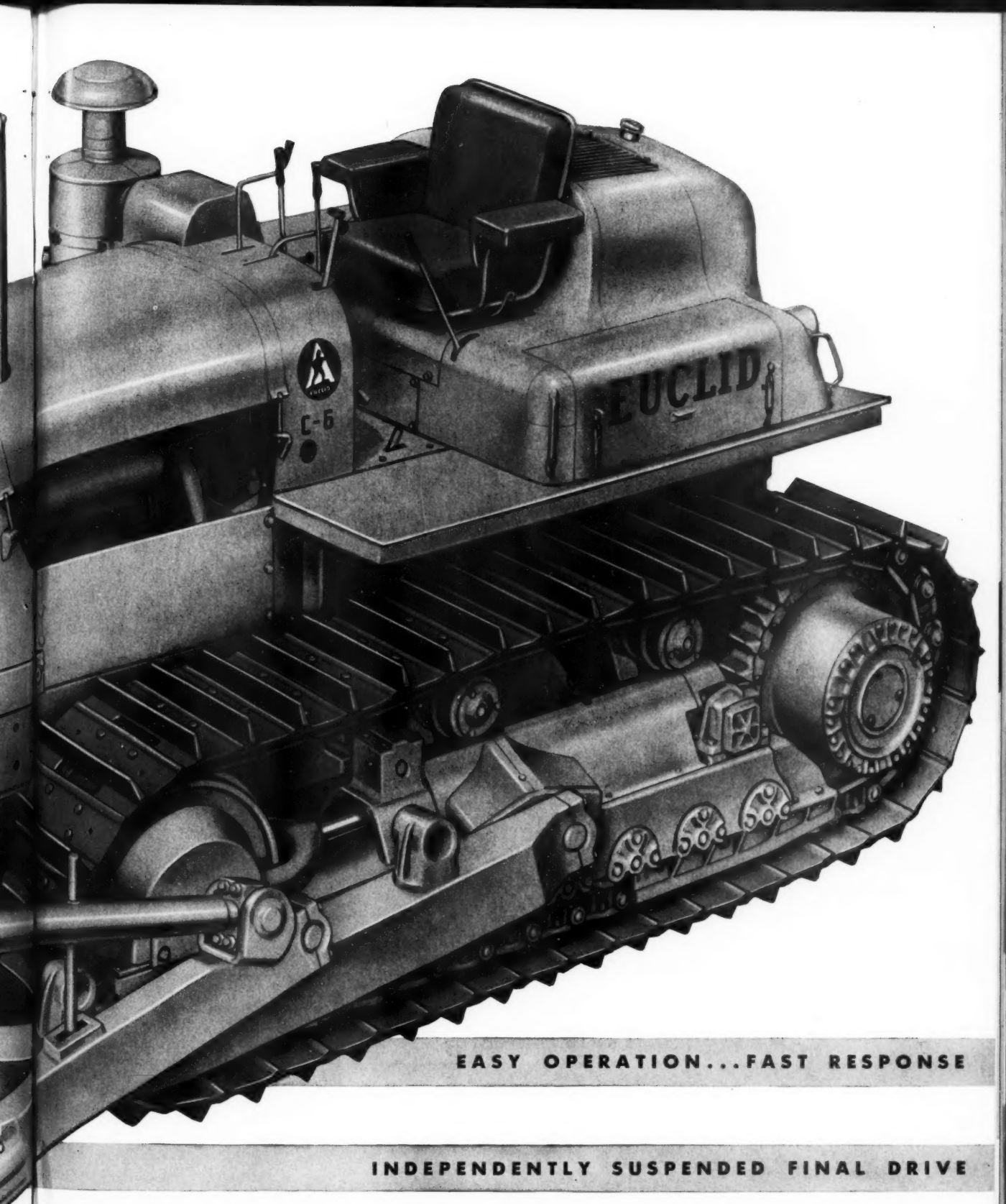
THE "EUC"

C-6

211 NET H.P.

FULL-POWER SHIFTING

PROVEN TORQMATIC DRIVE



EASY OPERATION...FAST RESPONSE

INDEPENDENTLY SUSPENDED FINAL DRIVE

OUTSTANDING ACCESSIBILITY...EXCELLENT MANEUVERABILITY

5 YEARS UNDER TEST...

the "EUC" C-6 provides New Crawler Standards

Proved by over 5 years of rugged field test . . . in mines, quarries, heavy earthmoving and logging as well as on the proving grounds. With 211 net hp. and proven Torqmatic Drive, the C-6 features full power shifting and time-saving maneuverability . . . has plenty of power and speed for dozing, ripping, pushloading scrapers and all other big tractor work.

Operators report that excellent visibility and over-all ease of handling give the C-6 smooth performance that gets more work done every shift . . . and with less downtime for service and maintenance.

EASY SERVICING

Maintenance designed—the C-6 has exceptional accessibility and all major components are "out in the open"—easy to get to. For example, the engine is easily serviced or removed, and the converter, transmission, steering brakes and clutches assembly can be removed as a complete "package" without major disassembly . . . final planetary drives can be serviced without removing sprockets or breaking track . . . there are considerably fewer lube points than in competitive tractors.

Have your Euclid Dealer give you the performance facts that prove the C-6 assures a better return on investment

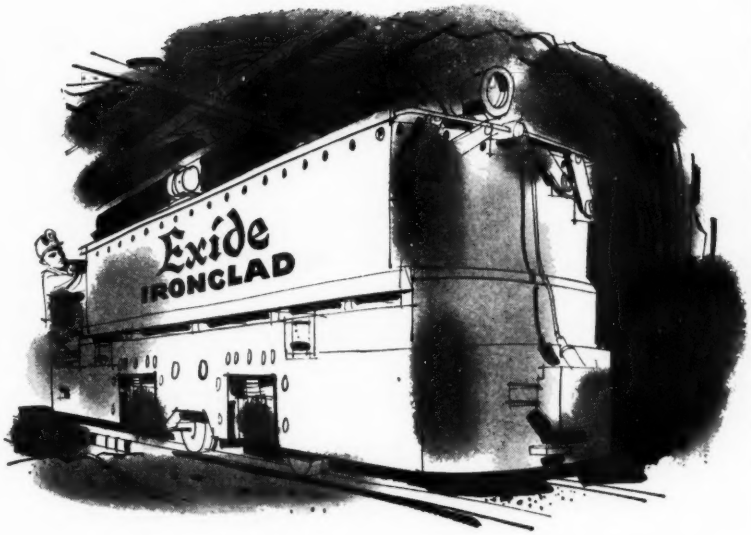
EUCLID DIVISION OF GENERAL MOTORS

Cleveland 17, Ohio

EUCLID (GREAT BRITAIN) LTD.
Lanarkshire, Scotland

. . . a complete line of equipment for heavy earthmoving, mining, logging and many industrial operations . . .

Printed in U.S.A.



EXIDE-IRONCLAD BATTERIES

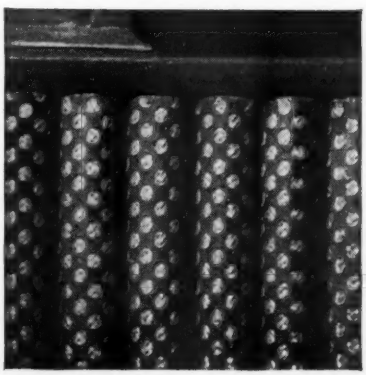
—best buy for the long haul

More ton-miles per dollar—that's the reason most cost-conscious mine operators prefer Exide-Ironclad Batteries for mine locomotives.

Experience has proved over the years that no other battery make matches Exide-Ironclad for average life in service and tonnage hauled. Rating for rating and dollar for dollar, Exide-Ironclad gives you more real value . . . more return on your investment.

Today's Exide-Ironclad features improved tubular construction, making it even better than the models that chalked up the industry's records. So you can expect even longer life potential and superior performance.

Total work output, not mere price, is the key to battery economy. When you buy batteries, specify Exide-Ironclad and get the most production capacity your dollar can buy. For details, write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.



50 years ago, Exide patented the now-famous Exide-Ironclad tubular positive plate battery. For power and economy, nothing has ever matched it. Yet Exide engineers have constantly improved it. Today's battery packs more power, gives longer life and greater economy than ever before.

Exide®

New York Times States:

"OVER 190 BILLION CUBIC FEET OF FRESH AIR

are pumped into our coal mines during every day of the year. Weight of air circulated daily through a mine has been estimated at more than six times the weight of the coal mined that day".

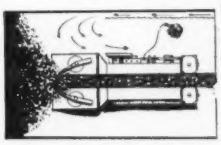
. . . but how much of it reaches the working face?

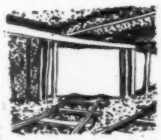
PLENTY

---if you use ABC BRATTICE CLOTH properly applied

- The finest quality jute fabric, tight woven to eliminate leakage.
- Correctly processed to resist flame, mildew and moisture.
- Dyed yellow to increase safety and improve working conditions.
- Various grades to meet all mining requirements.
- Also outstanding quality plastic brattice in yellow or brown.

For Temporary Stoppings





For Line Brattice

- **Send for Catalog on Brattice Cloth, Ventilation Tubing, Powder Bags, Trolley Guard, etc.**

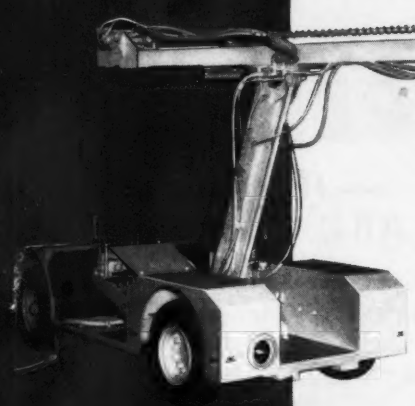
ABC AMERICAN BRATTICE CLOTH CORP.

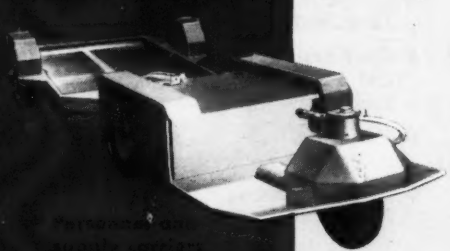
310 Argonne Road, Warsaw, Indiana

Now— as national sales and service representatives of the **LONG COMPANY**

AIRDOX CARDOX

offers a complete new line of LONG coal drilling and roof bolting machinery and personnel carriers for BOTH THICK and THIN SEAM COAL OPERATIONS





Sales, parts and service for this new line of LONG equipment are provided through AIRDOX CARDOX Warehouses and District Offices, strategically located in all major coal producing areas.

Each item in the new line of LONG equipment has been specifically designed to speed up and/or simplify one or another drilling, roof bolting or transport job within your mine, to help you reduce operating costs.

Complete information and technical assistance is available to you from all Airdox Cardox field engineers, working directly with mine operators.

Ask your AIRDOX CARDOX Field Engineer for complete data on any of the equipment shown here. Or drop us a line and we'll arrange a meeting.

UNIFORM QUALITY...
CONSISTENT PERFORMANCE...
MAXIMUM SERVICE...

you get them all with

CARDOX®

carbide-tipped **bits**

Job-proven to give you *more* . . . in production, performance and service! In "show-down" tests in mine after mine, Cardox bits maintain a lower "cost-per-foot cut or drilled" rating than any other. It's no secret why . . . Cardox carbides are job-matched to meet your specific mining requirements, whether it be drilling or cutting. They are made to uniform quality standards . . . bit after bit, they deliver the same consistently high production output, the same long service life. They make continuous mining more continuous. Want proof? We'll be glad to run a test at your mine. You name the time, place and conditions. Bits available in all sizes and styles.

and

heat-treated alloy steel

augers

The all-new Cardox roof auger gives you 2-to-1 peformance over all others. Strong, rugged, long-lasting . . . Cardox roof augers are constructed of tough alloy steel, welded—then heat-treated for added strength and abrasion resistance. An extra pitch of flight at the shanks end provides added strength at the point of stress. In standard lengths from 10" on up; other Cardox augers are available from 1¼" to 48" in diameter. Same high quality, same high performance.

immediate service

lasting satisfaction

You can rely on Airdox Cardox for straight practical answers to your mining problems. We offer you a unique combination of experience, know-how, broadest distribution and stocking facilities, and available qualified underground personnel to answer your needs efficiently, effectively and economically. Call on us . . . where there's coal, there's . . . AIRDOX CARDOX!

AIRDOX CARDOX PRODUCTS CO.

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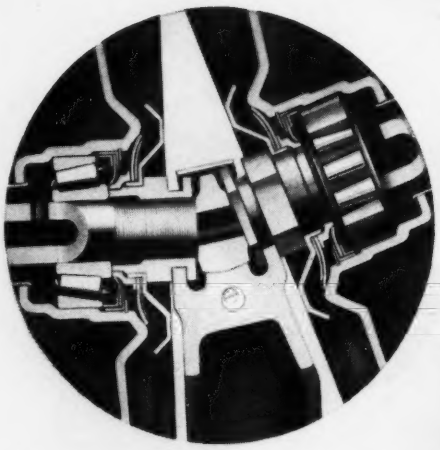
OTHER AIRDOX CARDOX PRODUCTS . . . Airdox and Cardox Non-Explosive Mining Methods . . . Auger Miners . . . Rotary Drills
Cardox Central Compression Systems for Air, Helium and other Gases



How **THE JEFFREY MFG. CO.** mounts Timken bearings in their Permaseal® idlers to maintain prelubrication and positive sealing, reduce maintenance.

Conveyor belt moves materials at less cost with Timken® bearings rolling the load

THIS huge conveyor belt does a whale of a job moving materials speedily and economically at these ore docks in Philadelphia. And to keep 'em rolling at lowest cost, the conveyor belt is supported by Jeffrey Permaseal® idlers with Timken® tapered roller bearings. This type of conveyor handles ore, coal, lime, over-burden, salt and gypsum. Timken bearings on these applications assure minimum maintenance, long bearing life because:

1) *They hold shafts concentric with housings,* making idler seals more effective in keeping dirt out, lubricant in.

2) *The tapered construction* of Timken bearings lets them take radial and thrust loads in *any* combination.

3) *Full line contact* between rollers and races gives Timken bearings *extra* load-carrying capacity.

4) *And Timken bearings are made of steel that's nickel-rich for extra toughness.*

The Timken bearing is the only tapered roller bearing proved by 40 years of service in heavy-duty conveyors using the popular dead shaft construction. For better performance at lower cost, be sure the machines you buy or build are equipped with Timken tapered roller bearings. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ont. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steels and Removable Rock Bits.*

This symbol on a product means its bearings are the best.

WHEN YOU BUY TIMKEN® BEARINGS YOU GET...

1. Quality you can take for granted
2. Service you can't get anywhere else
3. The best-known name in bearings
4. Pace setter in lower bearing costs

BETTER-NESS rolls on

TIMKEN®

First in bearings for 60 years

tapered roller bearings

WHYTE STRAND
Wire Rope is made for a purpose...

To give you the right rope for your equipment, each Whyte Strand wire rope is internally lubricated and designed to provide the right combination of toughness, flexibility, and abrasion resistance to assure maximum service.

Because Macwhyte manufactures a thousand and one wire ropes, you can be sure of getting just the right rope for each piece of your equipment.

You get quick delivery, too, from conveniently located Macwhyte distributors' stocks. For best results, ask for recommendations for the correct wire rope to use on your equipment!

MACWHYTE Wire Rope

Wire Rope made for a purpose—to serve you better

MACWHYTE WIRE ROPE COMPANY • **2900 Fourteenth Avenue** • **Kenosha, Wisconsin**

Manufacturers of special wire ropes for strip shovels, loading shovels, draglines, shaft hoists, haulage, underground scrapers, loaders, mining machines, conveyors, car pullers, and blast hole drills. 167


COORDINATION AND CONTROL
ENGINEERING
PROCUREMENT
TEAMWORK
CONSTRUCTION

GEARED TO DELIVER ORE DRESSING PLANTS AT GUARANTEED COST

THE M. W. KELLOGG COMPANY provides engineering, procurement, and construction services *in depth* . . . and *under one central management.* This unique concept achieves a degree of coordination and control that enables Kellogg to guarantee, in advance, what your major facility will cost.

In engineering, Kellogg excels in design and in layout and materials flow. Special groups of long experience handle mechanical equipment, structural engineering, foundations, electric power, furnaces and heat exchangers, instrumentation, and process engineering where needed. Mastery of modern materials handling methods brings new economies in capital expenditures and new savings in operating costs to clients.

In procurement, Kellogg criteria extend far beyond buying at the best price. To provide greater value in plant, to advance the day production can begin, every procurement activity is coordinated with engineering and construction needs. Encompassing purchasing, inspection, expediting, and traffic, Kellogg procurement is geared to the top management goals of providing the most plant per dollar.

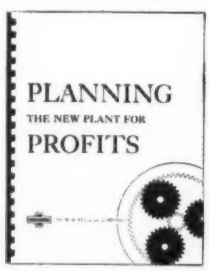
In construction, Kellogg stands unsurpassed in achieving top labor productivity, in devising economical solutions to tough erection or installation problems, and in keeping on schedule. Kellogg's construction department is organized to concentrate attention on these major areas: labor productivity, construction methods, construction planning, standards, engineering and inspection, tools and equipment, scheduling, administration, safety, and labor relations. A day-by-day check on progress *cost* is standard on Kellogg construction jobs.

What does this mean to you? Simply this: Kellogg's complete coordination and control assure the most efficient plant, in operation at the earliest possible date, at a maximum cost guaranteed in advance.

WIDE EXPERIENCE IN HEAVY CONSTRUCTION. The M. W. Kellogg Company is a world-wide contracting organization serving clients on all continents—Africa, Asia, Australia, Europe, North America and South America. For the world's industries, Kellogg provides integrated engineering-procurement-construction services and specialized facilities to build the most complex plants.

Founded in 1901, Kellogg has operated throughout the world since World War I. Since 1945, Kellogg has constructed more than 350 industrial plants—often handling 50 major projects concurrently. Some have been unique, high-capacity units embodying new process concepts. Many have been huge industrial developments basic to their national economies.

The revolutionary Kellogg way of doing business, well-established in other industries, is bound to have a profound effect on big mining projects. Why not let Kellogg engineers explore with you the ways in which they could best serve *your* interests? As a preliminary step, send for brochure—"Planning the New Plant for Profits".

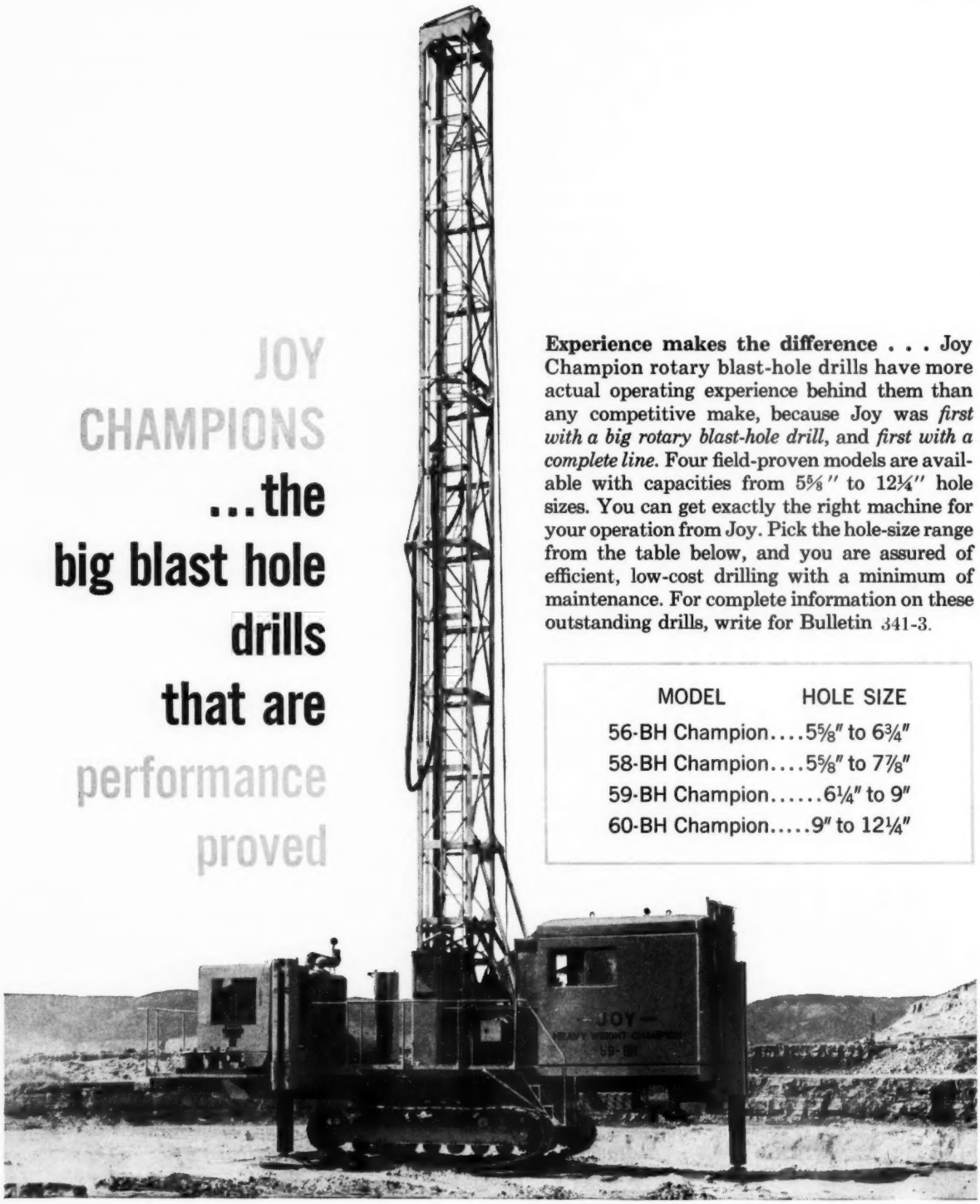


THE M. W. KELLOGG COMPANY
711 Third Avenue, New York 17, N. Y.
A subsidiary of Pullman Incorporated
Offices of Kellogg subsidiary companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires

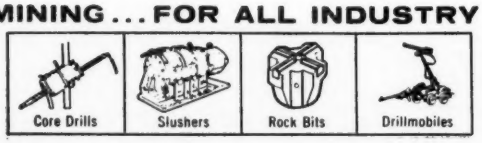
JOY
CHAMPIONS
...the
big blast hole
drills
that are
performance
proved

Experience makes the difference . . . Joy Champion rotary blast-hole drills have more actual operating experience behind them than any competitive make, because Joy was *first with a big rotary blast-hole drill*, and *first with a complete line.* Four field-proven models are available with capacities from 5⅝" to 12¼" hole sizes. You can get exactly the right machine for your operation from Joy. Pick the hole-size range from the table below, and you are assured of efficient, low-cost drilling with a minimum of maintenance. For complete information on these outstanding drills, write for Bulletin 341-3.

MODEL	HOLE SIZE
56-BH Champion	5⅝" to 6¾"
58-BH Champion	5⅝" to 7⅞"
59-BH Champion	6¼" to 9"
60-BH Champion	9" to 12¼"



EQUIPMENT FOR MINING... FOR ALL INDUSTRY



JOY

Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

5 reasons why Atlas Copco's "TIGER" is best for stoping and all short-hole drilling!

(1) It's fast and easy to handle!

(2) It's easy collaring, with little recoil!

(3) Features a retractable air leg!

(4) Convenient controls, automatic back head!

(5) Operates on single air supply!

Here's the TIGER—a new, fast, compact rock drill with power and stamina to meet toughest drilling requirements! Its high percussion rate not only speeds penetration, but at the same time cuts recoil to a minimum. With controls conveniently located, collaring is unusually easy.

What's more, the automatic back head prevents dry collaring. Flushing water actually flows before drilling starts. And, the Tiger's "constant blowing" provision sends air through the machine the instant pressure is turned on, keeping water and cuttings from the rotation chuck.

There's still another "plus"—the Tiger's exclusive integral type pusher leg, with retractable piston rod. Operates on a single air supply!

This isn't the whole story by any means. For more facts about the amazing new Tiger rock drill and how it can speed *your* drilling, call your nearest Atlas Copco representative. Or, write to us at Dept. MCJ-10.

Atlas Copco

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

"ONE OF THE MOST IMPORTANT QUALIFICATIONS for Jeffrey sales engineers," says W. G. Montgomery, District Manager at Bluefield, West Virginia, "is a keen power of observation. Thus he builds up experience that is invaluable to his customers." Montgomery is shown at Omar Mining Company, Omar, West Virginia, where Jeffrey recently system-engineered all cutting and loading equipment for Mine 15. The first new unit in service (cutter, loader and 2 shuttle cars per unit) has delivered 677 tons of clean coal per shift. Drift mine height is 39" to 56".

Jeffrey Service starts with system engineering

When you discuss your mining machinery requirements with Jeffrey, you will work with an experienced sales engineer.

He not only knows the ability of his equipment but knows coal mining, too. Years of experience with all kinds of mining conditions have made him adaptable . . . given him the know-how to help you achieve low cost production.

Thus the Jeffrey sales engineer studies your mining problem thoroughly. For example, a recent proposal for the mine of a major coal company included a complete study of the seam conditions and mining projection—indicating production, personnel requirements, predicted costs and equipment to do the job. This kind of system engineering pays off for the purchaser.

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EDITORIAL

ROBERT W. VAN EVERA, Editor

OCTOBER, 1959

AT Denver last month the problems of the mining industry received careful attention from leaders of all branches of the industry. Their considered views, formally adopted at the convention sessions, are summarized in the Declaration of Policy presented on pages 68 to 74 of this issue. We commend this statement to our readers and to those in our Government concerned with national mineral and fuel policies and the maintenance of a healthy domestic mining industry.

Measuring and Controlling Radiation in Uranium Mills

By R. E. MUSGROVE
Chief Metallurgist
Climax Uranium Company

Conscious of the potential health hazards in uranium milling, operators are continually seeking means to provide safer working conditions for their employes

OPERATORS of uranium milling facilities have encountered an industrial hygiene problem which is somewhat unusual in the ore-processing industry—exposure of mill personnel and the contiguous population to radiations which result from the decay of uranium and its daughter isotopes.

Perhaps, because of the novelty of the problem, or because of the calamitous nature of extensive radiation exposure as produced by nuclear explosives, a large segment of the popuation is apprehensive of radiation at any level of intensity. This concern is evidenced in the interest displayed by mill employes and by the coverage offered this subject by the press. Unfavorable publicity has accrued to the organizations which have not actively investigated the extent of radiation exposure occasioned by their operations.

The Atomic Energy Commission and others have established standards for the exposure of individuals to radiation. The author wishes to take this opportunity to praise the AEC for the way in which it has established these standards, and especially for the principle that the mill operator is responsible for measuring, evaluating, and controlling levels of radioactivity incident to his operation.

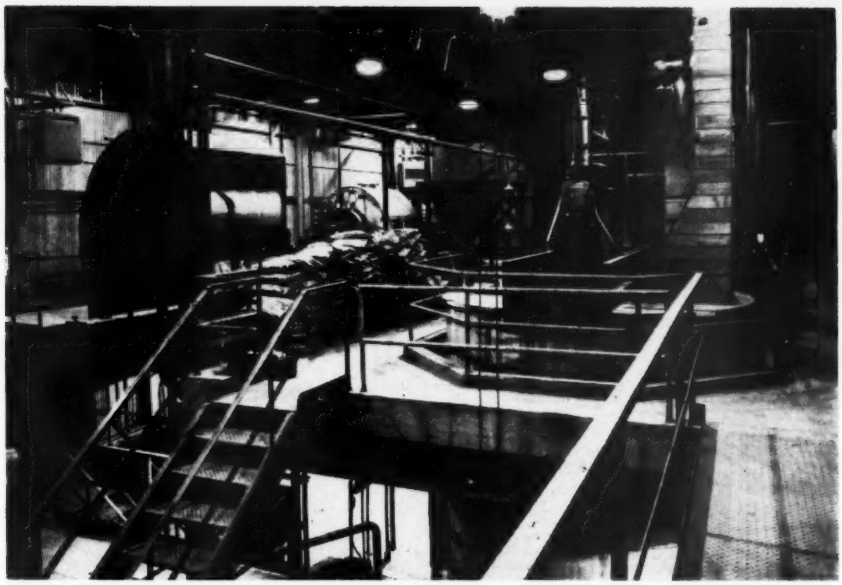
Merits of the particular values which have been chosen to represent the maximum permissible concentrations will not be discussed. Determination of that quantity of a radionuclide which is detrimental to human beings is a problem that may require years of study by those concerned with its solution. Until more precise data are available, there can be little but opinion as a basis for questioning these standards. At some level of radiation exposure, physiological changes do occur in an organism which necessitates limiting exposure to a level below that which would cause significant damage.

Since industry is happy with the standards prescribed by AEC and with the way they are enforced, there is only the matter of compliance which need give concern.

The methods that have been used in the radiation control program at the Grand Junction mill of Climax Uranium Co. are not exclusive, but are considered practical and accurate.

External Radiation Measurement

The dose of external radiation to which an individual has been exposed can be most conveniently determined by the use of film badges. These badges are sealed packages of photographic film and filters which integrate radiation exposure by proportional darkening of the film. The image on a developed film is measured and compared with the density of image produced by exposure of the same lot of film to known quantities of radiation. From the relationship between the standard and unknown exposure, the dose received by an individual is calculated. Film badges are available from several reputable sources that furnish developing and reading services. The supplier's reputation can be an asset if it



External radiation levels remain stable where good housekeeping is practiced

should be necessary to present film badge data as legal testimony.

In determining the dose of uranium mill employes, a four-week period of badge exposure is satisfactory. The film badges are normally worn outside of the clothing between the waist and neck, but in some working areas, it may be necessary to cover them with a plastic envelope to prevent external contamination. Consideration should be given to the effects of high temperature as a possible source of film fogging if the wearer works in areas of high temperature, and if badge readings cannot be reconciled with survey meter readings. Several extra badges should be included in each lot to allow for checks of in-transit radiation exposure, and to allow duplicate exposures for evaluating agreement between badges exposed to equal radiation levels. The accuracy of film badges is reputed to be plus or minus 20 percent of actual exposure.

It has been the author's experience that the external radiation level at Climax Uranium is below that which necessitates continuous personnel monitoring. At present a four-week film-badge survey of mill employes is conducted annually—a sampling period of this duration will give a statistically accurate index of annual dosage. In some plants, it is possible that gamma emitters might be concentrated at locations within the process, so that the external radiation level would be high enough to require continuous personnel monitoring, or possibly even control of personnel exposure.

A number of Beta-Gamma monitoring instruments are available; these serve to indicate relative intensity of external radiation and the source of this radiation. It has been the author's experience that the level of external radiation in a particular area is very stable over a period of time, if the housekeeping is reasonably good. External radiation monitoring instruments are useful in determining the existence and source of abnormal intensities and in evaluating effectiveness of control methods. Although instruments can evaluate the level of radiation in an area, they are not usually satisfactory for determination of the dose received by an individual.

Control of exposure to external radiation is well described in the literature. The principles which are used are reduction of exposure time, increasing the distance between the source of radiation and the subject, and shielding of the source.

Internal Radiation Measurement

The standards establish maximum concentrations for specific radionuclides in a unit volume of air; these concentrations are designed to limit the ingestion of radioactive material so that within the life-span of an individual, the total radioactive material retained in the body will be less than a harmful amount.

The first requirement of a program of measuring air-borne radioactive materials, is that samples collected are representative of concentrations to which workmen are exposed. It has been the author's observation that the procedures employed in several surveys have often ignored this requirement, and have based results on precise analysis of blunderingly collected samples. Sample collection is at best a compromise with accuracy; diligent thought and study should precede the application of a particular method to achieve the most accurate result.

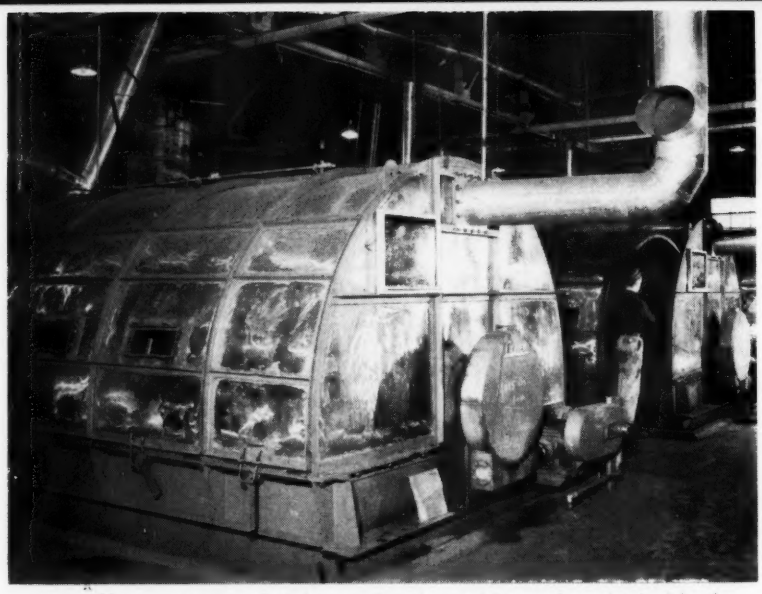
During the survey of an area at Climax Uranium two types of samples are collected simultaneously.

1. General air samples are collected in an attempt to represent average concentration throughout a room or area. Locations at which samples are collected are chosen after a preliminary survey, during which relative humidity, air currents, process equipment location, occupancy-time, and a "finagle-factor" of practibility of sampler locations are considered. Sampling devices are usually placed four to six ft above the floor.

2. Breathing-zone samples are collected as close as practical to the faces of the workmen in the surveyed area. These samples approximately represent the air ingested by a man during the course of his operational routine. They are taken as continuously as possible throughout the sampling period, which is usually from 24 to 80 hours duration in each area of the mill. The author believes this type of sample gives a reasonably accurate estimation of the integrated concentration of air-borne radioactive particles in air ingested by the workers.

General Air Samples

At Climax Uranium three types of sampling devices are used to collect general air samples:



Acceptable concentrations of air-borne radioactive particles can be maintained by the application of standard industrial ventilation and dust control techniques

1. The Staplex Hi-volume Sampler which draws 20 to 50 cfm through a pleated paper filter. Normally a Fixt-Flo Air Sampler Formed Filter manufactured by Mine Safety Appliances Co. is used with this sampler. This filter has an acceptable efficiency in collecting air-borne particles and it can be dissolved by mineral acids in preparation of the sample for analysis. At intervals, during collection of a sample, the flow-rate indicated by the instrument flowmeter is recorded; this data is used to calculate the volume of air sampled. The Hi-volume sampler is especially useful in sampling low concentrations.

2. The MSA Electrostatic sampler is a small electrostatic dust collector which samples at a rate of three cfm. This type of collector has an efficiency approaching 100 percent for all particle sizes. The equipment cannot be used in areas where humidity is high or where explosive vapors are present, but is very useful where high concentrations are sampled.

3. The Greenburg-Smith Impinger, although somewhat inefficient in collecting very small particles, is used in many areas where other samplers cannot be used due to high humidity or the possibility of flammable vapor concentrations. Collection efficiency is improved by using two impingers in series. This device is the least costly of the three samplers and is very convenient to use in areas where the plant vacuum system is available. In some of the surveys at Climax mill, 25 to 30 samples have been collected simultaneously within a departmental area using impingers supplied with vacuum by polyethylene pipe from plant vacuum pumps. Air flow through the impingers can be determined by rotometers, orifices, and displacement meters.

It is necessary to calibrate these three types of samplers frequently to assure accuracy in determining the volume of air from which a sample of dust has been collected.

Breathing-zone Samples

Breathing-zone samples are collected by drawing air through a molecular or membrane filter with vacuum supplied by a battery operated Gast Vacuum Pump. Air flow is regulated through a rotometer, and is held constant while a sample is being collected. Both the storage battery and vacuum pump can be carried throughout a shift without fatiguing the technician. The individual who is collecting the sample with this equipment is completely mobile, and because of this mobility, it is possible to collect a practically continuous sample during a shift. Lost time, less than 10 percent of the time available, occurs when filters are changed as a dust load is accumulated or when a recharged battery is obtained. The filters are composited into a single sample which represents the exposure to air-borne dust during an entire shift of the individual sampled. The breathing-zone sample is repeated several times during the survey of each area.

Collection efficiency of the molecular filter is approximately 100 percent for all particle sizes and decomposition of the filter material is easily effected by the use of mineral acids.

The second requirement of a measuring program is an accurate analysis of the radioactive material collected during sampling. Since the samples collected during the surveys are large it is possible to evaluate the uranium content by spectrophotometric analytical procedure. This procedure is sufficiently precise to permit accurate evaluation of uranium concentrations as low as 10 percent of the permitted concentration. In some surveys the air-borne concentration of radium, thorium, plonium, and radon daughters have been determined, and it has been found that uranium concentration is the determining factor in evaluating compliance with the standards.

All survey results are evaluated mathematically to determine actual average concentration and statistically normal deviation from the average expected within an area. Compliance with the standards is accepted if the average plus the positive variance at a 95 percent confidence level is less than the maximum permissible concentration.

Internal Radiation Control

Exposure of individuals to air-borne radioactive particles is limited by maintaining the concentration of these particles below the levels specified by the standards. Acceptable concentrations can be maintained by the application of standard industrial ventilation and dust control techniques. The methods and equipment for dust control and collection have been well developed and extensively applied but a discussion of them is beyond the scope of this article. It must be recognized that any dust collection device used for these applications must be capable of exhausting air which complies with the levels of concentration for effluents specified by the standards.

Personal respiratory protective equipment has a definite range of application in controlling the internal radiation exposure of individuals. It is recognized that a dust collection system or other dust control procedures are the desirable methods of control. It is also recognized that equipment is subject to mechanical failure and that some areas of a milling operation are occupied for a relatively short period of time each day. When individuals are exposed for short periods of time to concentrations higher than permissible, they may be protected by respirators.

The Los Alamos Scientific Laboratory specifies that the half-mask dust respirator can be used safely in atmospheres in which concentration of the contaminant does not exceed five times the permissible concentration. For exposures of less than 50 percent

(Continued on page 56)

POWER DISTRIBUTION in STRIP MINES at 7200 VOLTS

One of the first applications of 7200 volts in an open pit, portable, power distribution system was put into operation in the fall of 1955 at Hanna Coal Company's Georgetown No. 12 Mine. Here is an analysis of the design, operation, maintenance and economics of the system, with emphasis on the safety aspects

By R. V. BOVENIZER
Electrical Engineer
Hanna Coal Co.

THE ever-increasing capacity and digging power of stripping machines designed to remove 100 ft or more of overburden, and the attendant desire for operation at greater distances from the substation has created the necessity of using higher distribution voltages in order to handle the much larger blocks of energy needed to power these machines.

Experience with the 35 to 45-cu yd machines having approximately 1500 hp of a-c driving motors had shown that peak loads were about 2500 kw. Using the same ratio, the 60 to 70-cu yd machines, with 4650 hp of main a-c driving motors, could be expected to reach peak loads in excess of 7500 kw. Experience has also shown this to be true. Thus, it can be seen that

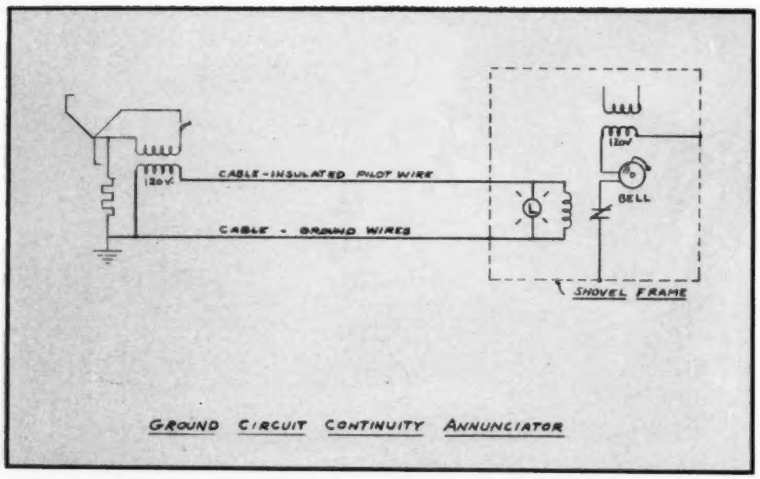


Fig 1. Method of monitoring the ground circuit of Hanna Coal Company's 7200-volt system. The insulated ground wire is energized at 120 volts a-c at the substation. A relay and an indicating lamp in the shovel are connected from the 120-volt pilot wire to the shovel frame. When the ground circuit is intact, the green safety light and relay are energized. An open ground circuit will de-energize the relay, and a normally closed contact will complete the circuit to sound an alarm

peak loads three times those of the smaller machines have to be handled safely and adequately.

It is obviously impractical to think of using larger portable cables, because operators of the 45-yd shovels had found it necessary to use 3/0 to 250 MCM cable sizes in order to get a desired range of 10,000 to 12,000 ft from the substation. Cables larger than these would be very difficult to handle and would be much more costly. Any combination of voltage and cable size that will limit the permissible distance between the substation and the shovel to a few thousand feet is obviously undesirable.

Power handling capability of a distribution system with a fixed cable size, distance and percent voltage drop varies as the square of the system voltage. The use of 7200 volts, which is a standard distribution voltage, would thus give a system three times the power handling capability that 4160 volts would. With peak loads as described, the 7200-volt system is a natural choice.

Auxiliary Equipment Power Supply

The necessity of using 7200 volts to power the larger shovels involves also the problem of power supply to loading shovels, drills and other auxiliary equipment in the pit.

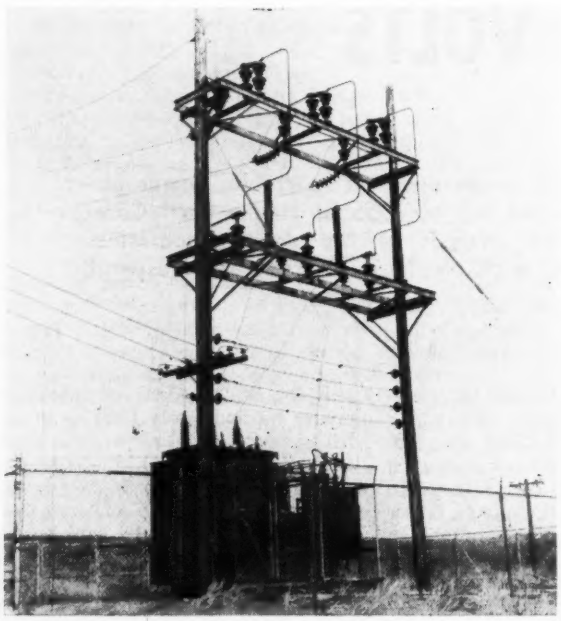
Method chosen can be one of several:

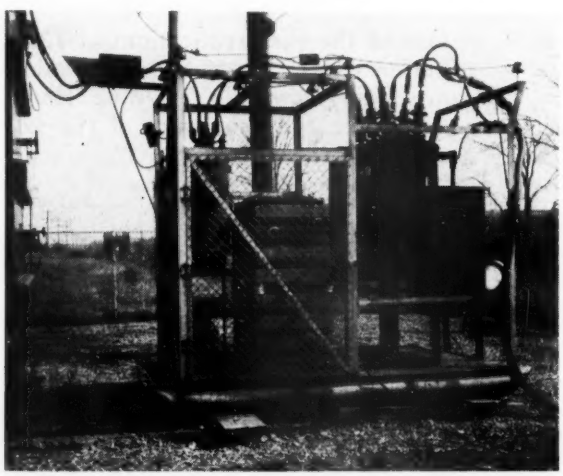
1. A complete separate (4160 volt) power supply. This involves handling two high voltage circuits in the pit. The additional cable, switches and connectors required would probably make this method the most costly.

2. To convert or purchase all auxiliary equipment to operate on 7200 volts. This would, of course, eliminate the need for two separate circuit voltages. The use of higher voltage normally permits smaller cable to be used. However, minimum cable size is sometimes determined, for smaller equipment, by the mechanical strength necessary for handling, rather than by electrical carrying capacity. Collector rings might be a problem when converting equipment to 7200 volts as greater clearances would be required. Transformation to a lower voltage at the auxiliary machines may be necessary where a-c motors are too small to be designed economically for the higher voltage.

3. A combination system using both (1) and (2). The main feeder cable to be 7200 volts and providing a means of tapping the circuit to feed one or more portable 7200 to 4160 volt substations. This method tends to minimize the long cable runs at the lower voltage because the tap can be made at a point nearer the auxiliary equipment.

No. 3 was the method chosen by





Figs. 2, 3. The semiportable 67 kv to 7200 volt substation (left) consists of a two-pole structure supporting the 67-kv switch, station type lightning arrestors and the high voltage fuses. Secondary bushings are connected to a portable skid-mounted circuit breaker unit (right)

Hanna Coal Co. to power the Mountaineer Pit. Several factors were involved in the decision:

a. It was desired to use auxiliary equipment already on hand and to keep it interchangeable with other pits at Georgetown as well as other Hanna strip mines in the area.

b. As this was probably the first application using 7200 volts in open pit mining, no record of experience existed to use as a yardstick in making a decision. The fact that portable cables were unproven at this voltage produced a natural reluctance to go all the way.

c. Because cable size for the auxiliary equipment could not be reduced significantly, and 7200-volt electrical equipment normally costs approximately 20 percent more than 4160-volt equipment of the same rating, there was no economical incentive to change.

General Design and Operation

Main factors to be considered in designing and operating a 7200-volt portable power distribution system are the same as those of any portable system at any voltage level. The system as a whole must:

1. Be adequate and reliable.
2. Have good voltage regulation.
3. Be SAFE.

Reliability. All components of the system must be rated to perform their necessary functions safely and continuously. The protective devices must be suitable and capable of detecting and interrupting short circuits, overloads and ground faults in order to protect personnel and limit damage to electrical and mechanical equipment.

Reliability can be built into electrical equipment, but there is no guarantee it will stay there without proper installation and maintenance. It should be inspected, tested and adjusted at regular intervals by properly trained personnel.

Voltage Regulation. This is a measure of the voltage drop in a distribution system. It is apparent that the voltage maintained at the a-c motors should not be allowed to fall below a certain design value if optimum performance is to be received.

It is general practice to design the power supply and distribution system for an open pit mine so that at peak operating demand the voltage does not fall below 90 percent of rated motor voltage and at no load does not raise to more than 110 percent of the same. The a-c driving motors for use on 7200-volt systems are usually designed for 6600 volts. Accordingly, with 6600-volt rated motors, voltage could vary from 7200 volts at no-load to 6000 volts at peak-load with an acceptable voltage drop. As almost all present day large shovels have synchronous driving motors and are equipped with automatic power factor regulating equipment, transformer regulation will be very low—normally about one or two percent at full load and unity power factor. Therefore most of the voltage drop in the distribution system will be in the lines and cables.

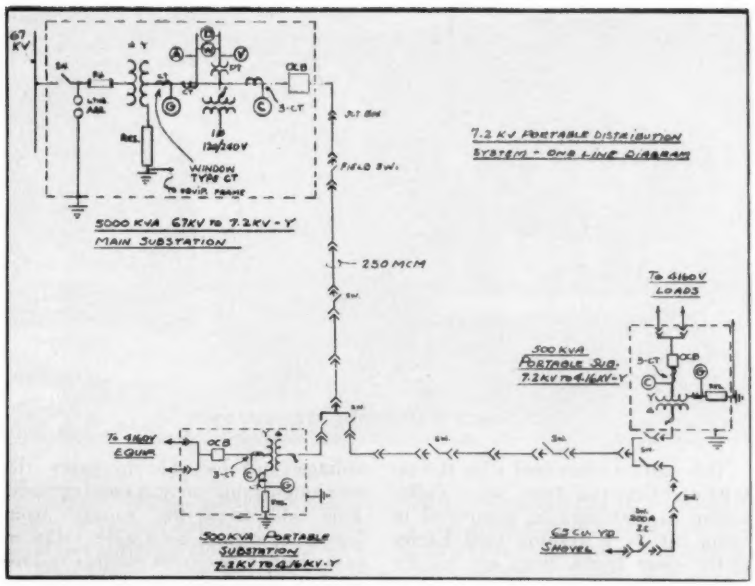


Fig. 4. Schematic diagram of the 7200-volt portable cable distribution system

In cases where very large motors are started across the line, the peak demand may be established during start-up. Usually these motors are designed to limit inrush current to approximately 350 percent of rated full load current. In these cases this is a factor to be considered in the final choice of transformer and cable capacity, although up to 35 percent voltage drop in starting across the line may be satisfactory, or even desirable, as it is comparable to low voltage starting.

Factors that determine cable size are current carrying capacity, maximum demand, desired regulation and transmission distance. The trend in distributing power in open pit mines has been, for the past several years, toward using an all cable system at the utilization voltage. A cable system affords better voltage regulation at the equipment than an overhead line using the same size conductor. Thus the equipment may be worked at a greater distance from the substation.

Safety Considerations. Use of 7200 volts introduces some new problems in operation and maintenance of electrical equipment in open pit mines.

Greater respect and care must be taken in all phases of installation, operation and maintenance.

Stress cones, at cable terminations, usually considered optional at 4160 volts are necessary at 7200 volts to prevent corona cutting.

Better housekeeping around insulators, especially at the shovel collector rings, is required.

Plug connections in the field should be protected to prevent moisture from entering because dangerous voltages due to tracking currents can exist along the cable jacket.

Prevention of Electric Shock

The most important safety problem in any open pit mine is, of course, the prevention of electric shock to personnel working on and around the electrically powered equipment. This hazard can exist when a phase to frame fault occurs on equipment not having a low resistant frame to ground connection.

It is only reasonable, then, that operating men might assume that the higher the distribution voltage the greater the shock hazard becomes. Actually, this is only relative. When one considers that as little as 1/6 amp for one second can cause death, and that voltages as low as 100 volts are sufficient to force this amount of current through the human body, then the final results of contact with various higher voltages are usually the same.

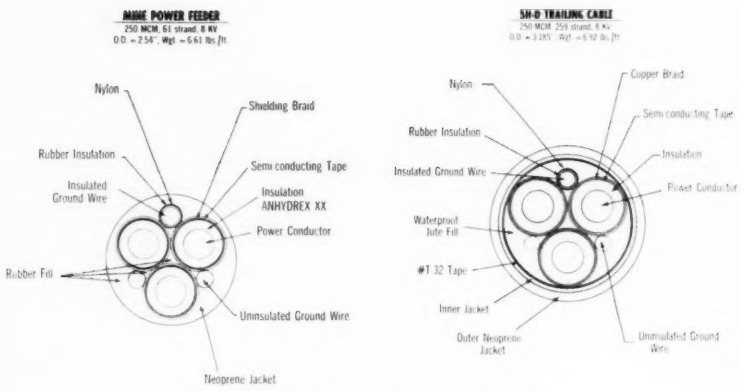


Fig. 5. General design of eight-kv portable cables

This can be compared with the results of being run down by a Volkswagon at 100 mph as compared to being hit by a 100-ton coal hauler at the same speed. Both are usually permanent!

The safety problem, as related to the prevention of the electric shock hazard, consists of limiting the equipment frame to ground voltage under ground fault conditions to a value considered not dangerous to human life. This value is usually chosen as 100 volts or less.

Fortunately, a method of providing a high degree of protection is available and has been in use in open pit mines for many years. It is called the high impedance grounded system, or perhaps better known as the safety ground system. Basically it consists of :

1. Providing the lowest practical impedance between the equipment frame and ground.

2. Limiting the ground fault current to a value that will keep the potential rise of the equipment frame above ground within a safe value.

3. Electrical equipment to quickly disconnect the faulted circuit. The above provisions are accomplished by:

1a. Having continuous, adequate ground wires from the shovel frame all the way back to the substation safety ground.

2a. Installing a resistor in the ground circuit, which is designed to limit the current that will flow under a ground fault condition.

3a. Providing sensitive relaying equipment that will detect the ground current and quickly disconnect the faulted circuit.

The resistor, installed between the transformer neutral and the substation safety ground, should be corrosion resistant, have welded or brazed connections, be rated at line voltage and be able to carry the maximum fault current continuously. This will limit the voltage from frame to ground to a safe value in case of relay or circuit breaker failure to operate. Grounding resistors in use today are designed to limit ground currents to 25 or 50 amp, with relaying set to trip the circuit breaker at a much lower current. Design should be based on a minimum ratio of three to one of maximum fault current to relay pick up current.

Available relays make it possible to relay currents as low as five amp. Thus a resistor to limit ground currents to 25 amp can still maintain a five to one ratio as a relaying safety factor.

The successful operation of this safety scheme is wholly dependent on the continuity of the circuit between shovel frame and the transformer neutral. This consists of the ground wires and the resistor. If any portion of this circuit is open, the desired protection is seriously impaired.

Therefore, it is evident that as long as the safety ground circuit is complete, the shock hazard under ground fault conditions, of a 7200-volt system, is no greater than those of lower voltage systems with the same protection.

Conversely, a greater shock hazard can exist with an open safety ground circuit, and the same equipment frame to ground contact resistance.

For added protection, consideration should be given to a monitoring scheme that will warn personnel when the ground circuit is open. This can be accomplished by providing an insulated pilot wire in the cable.

Figure 1 shows the method of monitoring the ground circuit of Hanna's 7200-volt system. The insulated ground wire is energized at 120 volts a-c at the substation. A relay and an indicating lamp on the shovel are connected from the 120-volt pilot wire to the shovel frame. When the ground circuit is intact, the green safety light and relay are energized. An open ground circuit will de-energize the relay, and a normally closed contact will complete the circuit to sound an alarm.

Regular ground continuity checks should be made on all systems not having a ground continuity monitoring circuit.

All industries using portable electrical machinery requiring high voltages would welcome the development of a device that would detect an open ground circuit without the use of pilot wires in the cable.

Hanna's 7200-Volt Power Distribution System

What was probably the first application of 7200 volts in an open pit, portable, power distribution system was put into operation in the fall of 1955 at Hanna's Georgetown No. 12 Mine. It was installed to power the new super shovel known as the "Mountaineer."

This machine has a total of 4650 hp of a-c synchronous motors driving 2750 kw of d-c generators to power 3200 hp of dc motors. Auxiliary a-c motors total an additional 1350 hp. bringing the total a-c connected load to 6000 hp.

Power to service Hanna's various operations is purchased through a single metering point and distributed at 67 kv over approximately 100 miles of company built and maintained transmission lines. The present system demand is 22,000 kva.

The 67-kv line is extended to a substation location, on the highwall side of the pit, which will serve the pit for as long a period as possible without moving the substation and is designed to keep the Mountaineer within a maximum working distance of approximately 15,000 ft from the substation.

Figure 2 pictures the 67 kv to 7200-volt substation. It is a semi-portable arrangement consisting of a two-pole structure supporting the 67-kv switch, station type lightning arrestors, and the high voltage fuses. The fuses are connected to the transformer primary bushings. Secondary bushings are connected to a portable skid-mounted circuit breaker unit shown in figure 3. The grounding resistor, metering, breaker operating and protective devices are mounted on the unit also.

A one-line schematic diagram of the 7200 volt system is given in figure 4.

All station equipment, including

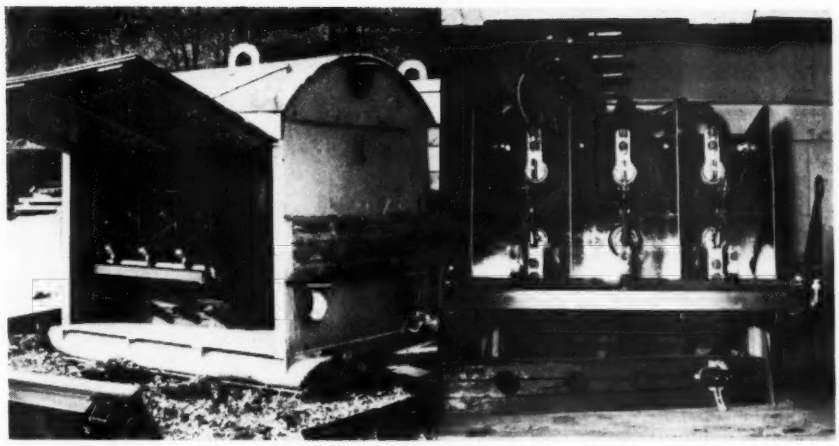


Fig. 6. Two views of skid-mounted field disconnect switches. Note how the incoming male plug connectors at the top and outgoing female plug connectors at the bottom are clamped at appropriate spacing in wood blocks

the wire fence, is grounded to the station ground. The transformer is 5000 kva, 67 kv to 7200 Y/4160 Y with seven percent impedance. This unit has a special secondary winding to permit inter-changeability with a similar unit feeding the huge Georgetown preparation plant.

Neutral grounding resistor is 96 ohms, 7500 volts, 50 amp, continuously rated. Using a ground wire resistance of 1.2 ohms, maximum fault current is $7200/1.73 \times 97.2 = 43$ amp. Maximum frame to ground voltage = $43 \times 1.2 = 52$ volts.

The station ground is installed a minimum of 50 ft from the safety ground in order to prevent the possibility that high side fault currents or lightning surges, in flowing into the ground, might raise the potential of the adjacent safety ground.

Oil circuit breaker is rated 600 amp, 14.4 kv, 100,000 kva interrupting capacity. It is electrically operated, capacitor trip, with a single shot reclosure after 55 seconds. A second trip-out before 60 seconds has elapsed will lock out the breaker; otherwise, it is reset for another cycle.

Overcurrent relays are set at 800 amp with instantaneous trip at 1200 amp. A window type current transformer is used to detect ground fault currents. A ground fault current of 17 amp will actuate a relay to trip the circuit breaker.

The 7200-volt supply is connected directly to the equipment cable. This cable is extended out to the highwall and dropped over at a point near the Mountaineer. Usually the shovel is out on approximately 15,000 ft of cable. It is in 1000-ft sections. The first 13,000 ft (from the sub) is mine power feeder type, with the remaining 2000 ft being SHD type for necessary flexibility.

Figure 5 shows general design of the two types of cables.

Major specifications are as follows:

Mine power feeder—250 MCM, 61 strands, 8 kv grounded, 12/64-in. wall insulation, 2—No. 2-37 strand ground wires, 1—No. 2-37 strand insulated ground wire—4/64-in. insulation.

SHD cable—250 MCM, 259 strand, 8 kv grounded, 15/64-in, wall insulation, 2—No. 2-133 strand ground wires, 1—No. 2-133 strand insulated ground wire—4/64-in. insulation.

Each 1000 ft length of cable is terminated at each end in a molded pothead, with the three main conductors extended out into single conductor, molded, eight-kv plug connectors. Stress cones are factory installed approximately 18 in. from each plug. The two ground wires and the pilot wire are spliced in the pothead and extended out as Type W cable to terminate in a three-pole polarity plug connector. Cable plugs are connected and protected from exposure in covered box type enclosures or in company manufactured field switch boxes containing one or more gang operated switches. Where wood boxes are used, the plugs are taped at the seal as an extra precaution to keep out moisture. Use of the field switch boxes enables the cable to be tapped conveniently and safely and permits cable sections to be isolated for quickly locating faults.

Figure 6 shows a close-up view of a field switch box containing two switches. Notice how the incoming male plug connectors at the top and outgoing female plug connectors at the bottom are clamped at appropriate spacing in wood blocks.

The field switches are three-pole, gang operated by hook stick, 400 amp. Devices giving the switch an interrupting capacity of 200 amp may be added where desired. A switch with interrupters installed is used in the pit near the shovel to permit de-energizing the shovel for a cable change without the necessity of open-

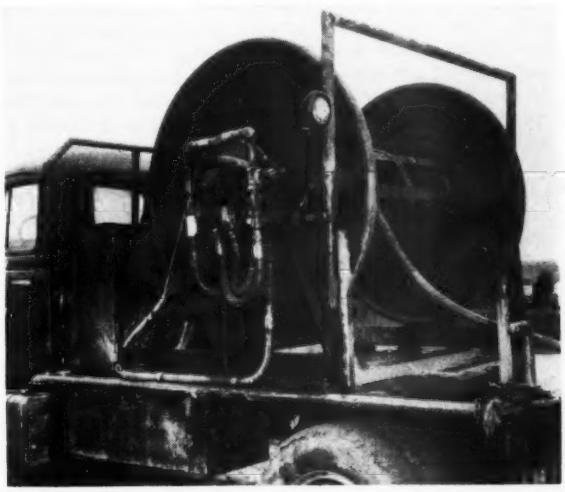


Fig. 7. Cable handling labor is held to a minimum by the use of specially designed cable reel trucks. Reels are hydraulically operated in such a manner that one man can collect a full reel of cable

ing the main station breaker.

Field boxes, containing from two to four switches, are used at desired intervals to feed the pit auxiliary equipment transformers.

Cable faults, located by high voltage cable fault finder if necessary, are usually repaired in the field until such time as three or four temporary splices are accumulated. The cable is then taken to a local cable repair shop where the cable is repaired, vulcanized, and tested with modern factory procedures.

Cable and plug experience in 3½ years to-date has been such that there have been no failures directly attributable to the use of 7200 volts.

Cable handling labor is held to a minimum by the use of specially (Hanna) designed cable reel trucks as shown in figure 7. The reels are hydraulically operated in such a manner that one man can collect a full reel of cable.

Figure 8 pictures how auxiliary pit equipment operated at 4160 volts is supplied by either of two 500 kva, 7200 volts delta to 4160 volt Y portable transformer substations. These units are tapped to the 7200-volt cable at the field switch boxes and contain the complete station equipment, fused cut-outs, transformer, oil circuit breaker, grounding resistor, relaying equipment, and outgoing plug connectors. Excellent maneuverability over the rugged terrain is obtained by mounting the complete substation on a rubber-tired lowboy trailer with a gooseneck hitch.

A ground fault on 4160-volt cable or equipment will be isolated by the circuit breaker on this unit and not affect the 7200-volt substation.

The same general plan of distribution is used at 4160 volts as with the 7200-volt system, i.e., the same splice boxes, field switch boxes, single pole plugs, etc.

A different size of connecting plug is used for all connections on the 4160-volt cables so as to minimize the chances of interchanging the two pit voltages.

Conclusions

Continuous satisfactory operation of strip mining equipment depends a great deal on the power distribution system. Careful selection of all the electrical components is an economic necessity.

The problems associated with the use of 7200 volts in open pit mining can be solved in the original planning of the system and in proper maintenance of switch gear, cable and protective devices.

Fig. 8. Auxiliary pit equipment operated at 4160 volts is supplied by either of two 500 kva, 7200 volts delta to 4160 volts Y portable transformer stations. Excellent maneuverability over the rugged terrain is obtained by mounting the complete substation on a rubber-tired low-boy trailer with a gooseneck hitch

With properly designed and maintained safety ground protection, 7200-volt portable distribution system can be made as safe as a lower voltage system.

The use of 7200 volts is necessary when powering the 60 to 70-yd machines. Also, in some cases 7200 volts would be advantageous for new installations of machines in the 45-yd size range. This would depend on the mine layout and the desirability of avoiding the necessity of frequent relocation of the mine substation.

Development of larger power shovels is certain to require even higher utilization voltages, and 13,800 volts is the next higher standard voltage. Design and development of portable cable, field switches, and methods of connecting cable lengths to apply to portable equipment at this voltage may be required in the near future.

MEASURING RADIATION

(*Continued from page 50*)

of the work day the upper limit of air-borne contamination is 10 times permissible. For a full-face mask the concentration should not exceed 50 times the permissible concentration. With supplied air equipment, it is possible to occupy areas of higher air-borne concentration with safety.

In using personal respiratory protective equipment, it is necessary that the best possible fit is obtained and that the masks and filters are in excellent condition. Although it is possible to protect individuals exposed to air-borne radioactive particles by the use of respirators, every effort should be made to provide an occupational environment which is compatible with the standards.

The program which has just been described has evolved over a period of approximately two years, and the author is confident that future refinements will result in lessened cost and improved reliability.

At this stage of their development, it is felt that the procedures have given reliable information on the existence and maintenance of a satisfactory radiation level at the Climax Uranium Co. mill.

REFERENCES

1. "*Standards for Protection Against Radiation*," Title 10—Atomic Energy, Chapter 1—AEC, Part 20, Federal Register, Jan. 29, 1957.
2. "*Proposed Amendment*" dated April 24, 1959. to "*Standards for Protection Against Radiation*," Title 10—Atomic Energy, Chapter 1—AEC, Part 20, Federal Register, Jan. 29, 1957.
3. "*Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure*" Bureau of Standards Handbook 69, June 5, 1959.
4. Jerome E. Dummer, Jr., editor, "General Handbook for Radiation Monitoring," LA-1835 (3rd ed.). U.S. Government Printing Office, November, 1958.
5. N. Irving Sax, "Dangerous Properties of Industrial Materials," Reinhold Publishing Corp., New York, 1957.
6. B. T. Price, C. C. Horton, and K. T. Spinney, "Radiation Shielding," Pergamon Press, New York, 1957.
7. "Atomic Radiation," *RCA Service Co.*, Camden, N. J., 1959 Revised.
8. "*The Industrial Environment—its Evolution and Control*," USPHS Publication 614, 1958.
9. F. A. Patty, Editor, "Industrial Hygiene and Toxicology," Interscience Publishers, Inc., New York, 1958.

Mixed with appropriate percentages of low cost fuels, ammonium nitrate (AN) provides the cheapest source of explosive energy available. AN, because of its low cost and high explosive potential in oxidation-reduction ("redox") mixtures, has been used extensively in the explosives industry from its very beginning

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AMMONIUM NITRATE EXPLOSIVES

THE Swedish scientists, Ohlsson and Norrbin, patented explosive (redox) mixtures consisting of AN with various fuel sensitizers which included charcoal, sawdust, napthalene, wood pulp, and nitrobenzene as early as 1867. Nobel, who inaugurated the high explosives industry in the early 1860's, acquired the Ohlsson-Norrbin patents, and within the first decade of the high explosives era, introduced AN into dynamites in two series which he called "extra" and "ammonia-gelatin" dynamites. Subsequently, the use of AN increased steadily until about 1930 it comprised possibly as much as two-thirds of dynamites. Up to that time commercial uses of high AN, non-NG (NG = nitroglycerine) explosives had been relatively limited but military usage had been large owing to extensive applications in World War I of the amatols. In 1932, a powerful new series of fuel-sensitized AN blasting agents was introduced by DuPont under the trade name "Nitramon." This series gained rapidly in popularity and is currently in use, although in a rapidly decreasing amount, because of improved, modern blasting techniques based on less expensive systems.

It was the Texas City disaster that called to the attention of the mining industry the great potential of ammonium nitrate as an explosive. Shortly after the Texas City disaster, Lee and Akre patented the use of carbon-sensitized AN and other AN redox mixtures in polyethylene bags. It was soon discovered, however, that polyethylene bags were not required in dry holes and that they were not altogether satisfactory in wet-hole shooting because of a tendency for snagging on sharp edges. Operators thus were able to get around the Lee and Akre patent by pouring loose AN-fuel oil mixtures directly into the borehole. At first, prilled AN was introduced into the borehole; on top of each 80 pounds of AN about one gallon of diesel or fuel oil was poured, permitting it to run through the porous, absorptive AN. The mixture was fired with relatively large (usually multiple) "Nitramon" or dynamite boosters. While this was a very crude way to handle "prills and oil", that soon gave way to better methods, it marked an important turning point in open-pit blasting. Thus, with this "do-it-yourself" operation inaugurated on the Mesabi Range about 1954, began a new and exciting era of open-pit blasting.[1] Today, field-mixed ammonium nitrate-fuel oil (AN-FO) combinations comprise a substantial percentage of commercial blasting agents used in open pits.

Field Mixing of AN-FO

While blasting in the crude manner described above was surprisingly

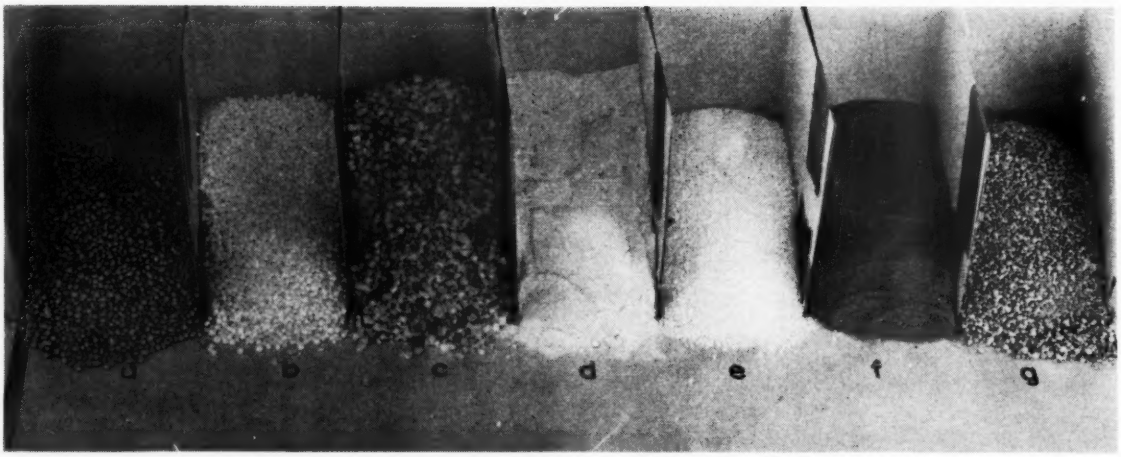


Fig. 1: Various types of AN: a—prilled, "guhr"-coated; b—"uncoated" prilled; c—HiD (guhr-coated) (Commercial Solvents); d—DuPont No. 3A graining kettle; e—DuPont No. 2 spray dry; f—Apache No. 1; g—Northwest Nitro-Chemical Special

successful, it soon became obvious that better mixing and control of composition to the approximately oxygen-balanced one (94/6 AN-FO) was essential for satisfactory field performance. To accomplish this, various methods were developed for field formulation of AN-FO mixtures. In one of the first methods devised, AN was poured through a funnel and fuel oil was injected through spray nozzles into the AN stream as it entered the borehole. Composition was controlled simply by adjusting the AN and spray nozzle flow rates. Several successful modifications of this procedure are currently in use across the country.

Later, at Kennecott Copper Corporation's Bingham Canyon pit, a similar method was developed in which AN was blown from a blow case through a tube to the bottom of the borehole, mixing it with fuel oil through spray nozzles at an appropriate point along the stream.[2] While this has proven successful for loading sprung toe-holes, completely satisfactory results are not always obtained as evidenced by the occasional appearance of the brownish-red fumes ("Krodochrome" clouds) characteristic of poor performance, improper mixing, and/or a deficiency of oil in the AN-FO mixture. For loading down-holes, the Anaconda Co. developed a method of simply pouring the required oil into bags of ammonium nitrate permitting it to mix by diffusion by letting it stand a few hours or days before using.[3] Even though this procedure is currently in use for shooting down-holes at a number of locations it is not very successful owing to non-uniformity of the product. One nearly always observes the "Krodochrome" clouds in this method.

Perhaps the best "do-it-yourself" operation so far developed for the 94/6 AN-FO mixture is that currently in use by Iron Ore Company of Canada [4] at their Labrador-Quebec operation at Knob Lake which was first described at the San Francisco AMC Mining Show last year (*Mining Congress Journal, Mar., 1959*). In it, AN is brought into the operation in bags and screened to remove large lumps; lumps are crushed and returned to the screen. Screened material is blown into a large storage tank where it may be taken off into a mixer as desired. During the blowing operation, the "guhr" coating is largely removed which is expected to improve strength, sensitivity and performance of the final 94/6 AN/FO mixture. AN is then mixed in a mixer with the proper amount of fuel oil to make a completely uniform 94/6 composition, which is an important feature of the IOCC operation. (One never observes "Krodochrome" blasts in using a product such as this unless attempting to shoot holes containing water, or in holes too small in diameter for the mixture to propagate satisfactorily.) The product is then loaded into a special truck equipped to blow the 94/6 AN-FO mixture into a 40 ft deep, nine-in. diam borehole in less than a minute. Moreover, the 94/6 AN-FO is metered during loading so that the exact borehole charge is known.

Another "semi-do-it-yourself" operation is that described by James Hyslop of the Hanna Coal Co. presented at the 1958 Mining Congress meeting.[5] Uncoated AN is screened, mixed thoroughly with oil, and then bagged in polyethylene lined burlap bags for use in dry holes or holes containing some water, as the case may be. Two mixtures were described, namely a 98/2 mixture for use in a special AN primer, and the 94/6 mixture for the main charge, both of which offer certain disadvantages. Firstly, by using AN-FO in bags one reduces the bulk loading factor through inability of packaged powder completely to fill the hole. This is a serious deterrent to the 94/6 AN-FO product, which already is seriously handicapped by excessively low density without adding a still further reduction in loading density. Secondly, while the product is made water-resistant by packaging in polyethylene-lined burlap bags, it is too low in density to sink in water. A sufficient column of powder above water level, of course, will force the slurry to the bottom, but this is troublesome in most cases and impossible in water-filled holes. Thirdly, the 98/2 AN-FO mixture is at best a poor, and in the last analysis a costly booster owing to low strength (about 500 cal per gm). The advantages, however, of good mixing achieved in this type of plant screening and mixing procedure are great enough to offset to some extent the disadvantages. Finally, mention is made of the fact that there are currently in existence (and this trend is likely to increase, no doubt, to the great benefit of large open-pit operators) operations in which mixing and loading of 94/6 AN-FO and similar explosives are contracted to explosives companies and jobbers set up to mix thoroughly and provide optimum loading and servicing for 94/6 AN-FO in bulk handling operations.

Types of AN Applicable

Ammonium nitrate used in AN-FO mixtures is generally prilled ammonium nitrate, which is a porous material that readily soaks up fuel oil, being almost unique in this respect. In fact, it is the free flowing and very absorptive character of prilled AN that has been largely responsible for the great success of the field-mixed or "do-it- yourself" AN-FO mixtures. If, in place of ordinary prilled AN, one were to employ in any of the above field-mixing procedures one of the following: (1) Hi-D AN made by the Stengel Process; (2) coarse "graining - kettle" or "spray - dry" products; or (3) even those prilled AN products that are sprayed in prilling towers with insufficient moisture and come out with excessively high densities—one would obtain inferior AN-FO mixtures. These mixtures would not only be difficult to detonate, but would not develop full strength and would nearly always exhibit the copious reddish-brown fumes characteristic of incomplete reaction and poor performance. On the other hand, Northwest Nitro-Chemical Ltd, Medicine Hat, Alberta, recently developed a special mixture of coarse and fine Stengel Process AN which appears competitive with prilled AN in field-mixed operations. This product is easily mixed with fuel oil and has excellent flow characteristics. Moreover, 94/6 NWNC AN-FO mixtures have a marked advantage over ordinary prilled AN-FO mixtures in density and borehole velocity. Thus, the NWNC product may prove to be an important step forward in this rapidly advancing field. Fig. 1 shows several AN products currently available for use in oil-sensitized and other high AN mixtures.

The prilled AN normally used is a "guhr"-coated product containing about 3.5 percent kieselguhr. However, several companies are currently marketing products with other coatings in order to improve sensitiveness and performance of AN. One of these is an organic material; specifically a surface-active, long chain hydrocarbon sulfonate. It should be realized that AN products made with such organic coatings are much more sensitive than those with inorganic coatings. This particular coating sensitizes ammonium nitrate very markedly even when used in surprisingly small quantities. Intermountain Research and Engineering Co., has found that 0.025 percent coating on prilled ammonium nitrate raised sensitivity to such a point that AN, which without coating would not propagate in 20-in. diam unconfined charges, could be detonated unconfined in nine-in. diam charges. Indeed, tests run with one commercial "uncoated fertilizer grade AN" containing 0.025 percent of this organic material had an eight in. unconfined critical diameter and a 160 gm cast 50/50 Pentolite ("Pento-Mex") minimum booster sensitivity. The sensitivity of the special organic-coated AN was nearly constant all the way from 0.02 to 0.5 percent coating. (Fig. 2) demonstrating it is incorrect and dangerous to call such mixes "uncoated." It was found that the sensitizing action of this surface-active, organic coating was such as to render FGAN products without any oil present in them, comparable in sensitivity to some less sensitive ammonium nitrate-fuel oil mixtures that have been used in open-pit blasting. This is called to the attention of open-pit operators in order that they may avoid difficulty in treating some so-called "uncoated" FGAN types as non-explosives. In connection with types of ammonium nitrates suitable for use in AN-FO mixtures, it should be pointed out that very finely grained AN-FO mixtures are high in sensitivity (sensitivity increases as particle size decreases). Indeed, one may easily make a cap-sensitive mixture by using sufficiently fine AN. It is possible to develop small diameter AN-FO mixtures for use, for example, in 1½ in. boreholes, if sufficiently fine-grained material is used, but care should be used in handling such mixtures because they sometimes attain relatively high levels of sensitivity. Indeed, some such mixtures are sensitive enough to be used in regular dynamite cartridges by dynamite methods.

Sensitivity

As has been pointed out, [6, 7] sensitivity of AN-FO types may be measured by three methods. One of these is the critical diameter—the smaller the critical diameter the higher the sensitivity of the mixture. The second method is to measure the minimum booster required to cause detonation and propagation, consistently in a diameter at least one in. above critical. A third way is to measure the so-called "sensitiveness", or the air-gap or card-gap distance over which a primer will detonate a receptor charge. In explosives of this type critical diameter and minimum booster measurements have been used much more than the "sensitiveness" method. Using these methods it is found in general that standard 94/6 AN-FO made with 3.5 percent "guhr" coated, prilled AN has a critical (unconfined) diameter of four in. and detonates with a 35- to 40-gm cast 50/50 pentolite booster. The amount of booster required to detonate the charge is considerably greater, however, with a dynamite or loose, low density, TNT booster. As far as the so-called "uncoated" ammonium nitrates are concerned, extensive studies during the past year reveal that none of the prilled ammonium nitrate products containing special coatings have unconfined criti-

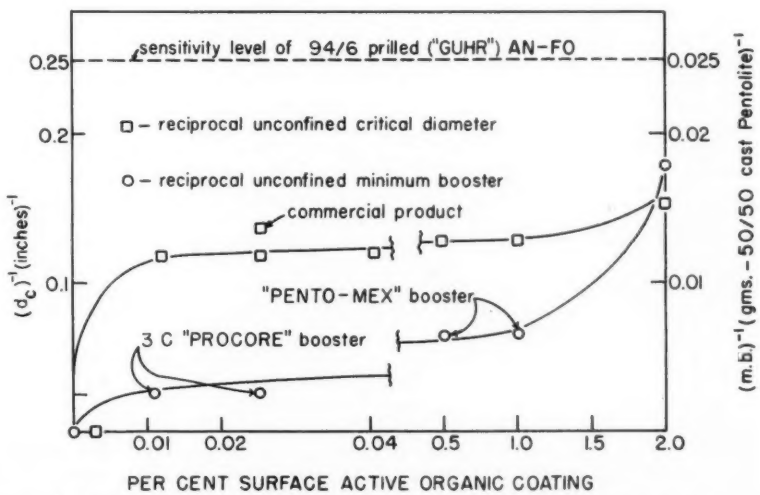


Fig. 2. Sensitivity vs percent surface active organic coating in "guhr"-free AN

cal diameters less than four in. However, many of these AN types with special coatings, e.g., surface active, organic ones, have considerably lower minimum booster sensitivities and some of them are even cap-sensitive. The trend toward increased minimum booster sensitivity is not in the interests of safe "do-it-yourself" operations and should be avoided. The performance of powder will be no better if it is cap-sensitive than if it is, say, sensitive only to cast 50/50 pentolite boosters of 40 to 100 gms. If its minimum booster is larger than 100 gm of cast 50/50 pentolite, however, its sensitiveness may be considered to be too low for practical field use. Therefore, it is of no advantage to increase the booster sensitivity above that of standard 94/6 prilled "guhr"-coated AN-FO .

Another important factor is that critical diameter in pipe confinement is considerably lower than in unconfined charges, but actually pipe confinement is not a realistic measure of borehole confinement. To illustrate, standard 94/6 prilled, "guhr"-coated AN-FO mixture has an unconfined critical diameter of four in. and a (½ in. thick) pipe-confined critical diameter of about two in. Conversely critical borehole diameter for this mixture in alluvium was found still to be four in. While critical diameter might be less than four in. in hard rock, advantage should not be taken of pipe-confinement to suggest the possible use of this product in smaller than four-in. diam boreholes. Whenever this product is used in smaller diameters, it is almost certain to cause difficulty from time to time. 94/6 prilled AN-FO has been used in smaller than four-in. diam, using boosters at regular intervals along the charge to keep the powder moving along. Heavy Primacord and in some cases 50 grain per ft Primacord have been used to shoot some of these mixtures in diameters as small as 1½ in. One can expect difficulty in routine operations attempting to use such mixtures in diameters below four in.

Velocity

A great deal of interesting and valuable data on detonation velocity have been accumulated for various types of ammonium nitrate-fuel oil mixtures in the IRECO laboratory (Figure 3) during the past year and will be presented this fall at the Missouri School of Mines' Annual Symposium on Mining Research. One of the interesting discoveries is that borehole velocity, even with 3.5 percent "guhr"-coated, 94/6 AN-FO mixture, is about 90 percent of the "hydrodynamic" velocity. This means that efforts to increase the unconfined velocity of 94/6 AN-FO would probably be of little value, because it is already performing satisfactorily under normal mixing and is used at nearly its full velocity. It has also been found that the unconfined velocity of uncoated AN-FO mixtures is usually less than that of "guhr"-coated AN-FO mixtures, all other factors being the same. Therefore, solutions to problems concerning velocity are not to be found in the types of coatings used.

Loading Density

One of the serious disadvantages of the ammonium nitrate-fuel oil type explosives is excessively low density that leads to low borehole pressure.[8] For example, 94/6 AN-FO has a density of only 0.8 gm per cc with a corresponding borehole pressure never exceeding 140 tons per sq in. in comparison with 450 to 500 tons per sq in. for the highest density gelatin dynamites and slurry explosives used in open pit mining today. Moreover, a much larger borehole is required for a given charge with the AN-FO than with conventional dynamites and slurry explosives with a correspondingly high ratio of drilling plus shovel to powder costs. Thus, with AN-FO mixtures, drilling costs are abnormally high because one can load into a given borehole much less powder than with other types, and shovel costs are frequently higher than normal because low detonation pressure causes reduced fragmentation. Therefore, the low cost of AN-FO mixtures is somewhat offset by higher drilling and shovel costs incurred in using these mixtures rather than higher density and borehole pressure types. Consequently, it becomes desirable to develop ways and means of increasing loading density and borehole pressure in mixtures of this type.

There are several ways in which this might be accomplished. One method would be the approach of NWNC in which the company blends both coarse and fine mixtures of high density ammonium nitrate, thus achieving high density products, and also obtaining high sensitivity and velocity by the presence of the fine-grained ammonium nitrate. Some further improvement in the density of AN-FO mixtures is possible simply by substituting some of the AN by sodium nitrate (SN). For example, a substitution of 15 percent SN does not reduce appreciably the weight strength but increases the density appreciably. Since SN has a much higher oxygen balance (O.B.) than AN a higher oil content is neeeded in AN-SN-oil than in AN-oil mixtures; for example, at an SN/AN ratio of 0.15 one should use about seven instead of six percent oil. Another high strength and high density ingredient suitable for use in AN-oil mixtures is ferrosilicon (FS). Since FS has a negative O.B., AN-FS-oil mixtures require less oil content relative to the AN-oil mixtures. We have studied AN-SN-FS-oil mixtures, on the other hand, with densities up to as high as 1.15 g/cc that still have sensitivities and weight strengths comparable to the AN-FO and velocities which are appreciably higher than with the low density AN-FO mixtures. However, there is a limitation to the density which one can achieve in the AN-FO types owing to a sharp fall off in sensitivity as density is increased above about 1.15 g/cc.

The most satisfactory solution to obtaining high density, non-nitroglycerin, high AN explosives, are the slurry explosives of the author and H. E. Farnam comprising coarse TNT-ammonium nitrate-water mixtures. Nevertheless, much remains to be done in the development of the slurry explosives before their full potential is realized. Before describing recent developments in coarse TNT slurry explosives it may be of interest to describe some attempts to achieve the desirable properties of these mixtures by other approaches. The author is aware of three separate attempts to arrive at high-density slurry-type explosives by other routes using wholly non-explosive materials as sensitizers for AN slurries. One of these was the use of ammonium nitrate-sugar-water solutions studied to some extent on the Mesabi Range. These were described by the author at the 42nd Annual Convention of the National Crushed Stone Association at Miami Beach, January 1959.[12] In studies of the ammonium nitrate-sugar-water mixtures in the author's laboratory, it was discovered that they could not be detonated with water contents in excess of 7.5 percent using oxygen-balanced AN-sugar mixtures; that is, at an AN/sugar ratio of 85/15. Like other AN redox systems, whenever the density of these mixtures exceeded 1.2 gm per cc, sensitivity became so low that the mixtures could not be propagated even in six in. diam steel pipe. Still, it was possible to obtain fairly good sensitivity with mixtures containing five percent water at densities in the range 1.1 to 1.15 gm per cc which was not at all unexpected. It has long been known that the maximum sensitivity in such mixtures is achieved at

a density around 1.0 to 1.15 gm per cc and that such mixtures are capable of propagation in large diameters at this density. If density were increased appreciably above 1.15 gm per cc sensitivity would fall off very rapidly such as to render the material incapable of propagating at a density above about 1.2 gm per cc.

Table I: IRECO evaluation of AN-molasses-water slurries

Uncoated Prilled AN	77%	80%	79%	78%	77%	74.2%
Molasses (20 percent H_2O)	23%*	18%	18%	17%	17%	16.3%
Water	0%	2%	3%	5%	6%	11.3%
Density (g/cc)	1.29	1.38	1.42	1.43	1.49	(Separates)
Critical diameter	F**	9	7	9	F	F
Minimum Booster (grams, cast 50/50 pentolite)	F**	400	400	400	F	F

* Amount required to make a pourable slurry

** F means failure in nine-in. diam by 18 in. unconfined charge using a "Procore" 3C booster.

Another mixture of a similar nature being studied on the "Range" is a mixture of 92/8 AN-powdered coal. In studies by IRECO this mixture required about 10 to 13 percent water to render it incapable of propagating in six-in. diam steel pipe. However, again the cut-off density for propagation in six-in. diam steel pipe was about 1.2 gm per cc. Recently another such mixture came to our attention, namely, a mixture consisting of molasses, water and AN.

The molasses-water-AN system was evaluated by IRECO. They followed the prescribed procedure of pouring a 1.5 gal water-1.5 gal molasses solution into an 80-lb bag of prills, then dumped the slurry into a nine in. tube and attempted to fire it with a booster of strength equivalent to 400 gm of cast 50/50 pentolite. They were, however, unable to detonate it unconfined. Next they determined the critical diameter and minimum booster of various well-formulated slurry mixtures with the results shown in Table I.

The molasses slurry made with three percent water and 18 percent molasses (containing itself 20 percent water) is apparently the optimum slurry mixture of this type. This mixture is much better than the ammonium nitrate-sugar-water and ammonium nitrate-coal slurries as far as sensitivity is concerned. However, its sensitivity is still only marginal. It does shoot unconfined in seven to nine-in. diam at surprisingly high density, but requires a very powerful booster to detonate it.* Craters produced by this mixture showed that the AN-molasses-water mixture is definitely low in weight strength. This is compensated to some extent, however, by its high density, the loading density being 80 percent greater with the molasses slurry than with prills and oil. One, therefore, should realize good blasting action with these slurries for hard rock despite the low weight strength. On the other hand, the mixtures are considerably inferior to the coarse TNT slurries. One should not overlook the fact that mixtures of this type generally have low thermal stability and therefore exposing them to high temperature environments and prolonged storage where they are liable to show self-heating should be scrupulously avoided.

** Since this writing the discovery was made that the molasses slurries undergo serious deterioration in sensitivity upon aging even over relatively short times of less than an hour.*

Field-Mixed and Plant-Packaged Slurry Explosives

The new coarse TNT slurries comprise basically ammonium nitrate, coarse TNT, and water. These have been described at length in previous publications.[9, 10, 11] The most important development during the past year concerns modifications in formula that make it possible to shoot slurry mixtures in very small diameters, e.g., in one to two in. diam, and which make for good fumes for underground use. It is only necessary to increase TNT content of the AN-coarse TNT-water slurries to about 35 to 40 percent in order to reduce critical diameter to the small diameter range but, when TNT content is increased to this level the oxygen balance is made sufficiently negative that the mixtures will not develop satisfactory fumes for underground use. Therefore, in order to achieve good fume qualities as well as the ability to propagate in small diameter charges it is desirable to replace some of the ammonium nitrate by sodium nitrate.

A particularly desirable mixture for use in small diameters is the slurried high density 36/32/32 coarse TNT-ammonium nitrate-sodium nitrate mixture which requires only about 10 percent water to slurry it. The product can be gelled and cross-linked by means of 3 percent guar gum and 0.3 percent sodium borate (water basis), respectively. It appears that the fumes of this mixture may be appreciably better than for regular dynamites used underground. Not only is its critical diameter within the desired range but the minimum booster sensitivity is also good. This applies, of course, to the use of the pelleted type TNT ("Nitropel" or "Pelletol") and to "flaked" TNT as well, providing, of course, that the flaked TNT does not have in it an

The free-flowing and absorptive character of prilled AN has been largely responsible for the success of "do-it-yourself" AN-FO mixtures. Premixed AN-FO, which offers the advantage of being a uniform product, is becoming available through explosives companies and jobbers to the benefit of the mining industry

Fig. 3. "Procore" boosters and their plate-cutting action. (Boostering action varies directly as plate-cutting action)

appreciable amount of fine-grained TNT. The finer TNT in the flaked product has a disadvantage not only in increasing hazard in preparing mixtures but also it tends to reduce sensitivity of the final slurries. A very interesting fact is that critical diameter in general decreases as the density increases. For example, in one series, the density of the 36/32/32 coarse TNT-AN-SN mixtures increased from about 1.55 with five percent water to a maximum of 1.68 with 20 percent water, and then began to fall off with a further increase in water. At the same time critical diameter decreased from two in. with five percent water to less than one with 20 percent water and then underwent an increase reaching two in. at 40 percent water. The fact that the minimum critical diameter occurred at the maximum density is a striking illustration of the importance of *continuity-of-phase* in the propagation of slurry explosives. By making use of this fact some very attractive small diameter explosives have been formulated. Field trials are being planned to determine the properties of these mixtures in small diameter holes for underground blasting.

It is fortunate that such mixtures propagate satisfactorily when made up with excess water. This makes it possible to use "placers" with which the slurry material is introduced into the borehole by blowing techniques. Also, it is possible to package these mixtures in cellophane tubes and use them directly in much the same manner as in blasting with dynamite. It should not be necessary, however, to slit the tubes when using slurry explosives in cellophane tubes since the tube will expand when the charge is tamped.

Slurry explosives are currently in extensive use in Canada, being manufactured by the Canadian Industries Ltd. currently at a rate of more than a million pounds per month, under the trade name "Hydromex W" and "Hydromex D". They have not developed to this stage in the United States, although the DuPont Co. is currently offering it under the trade name "Tovex". It is anticipated slurry developments will continue and that they will reach an important level in this country in the near future. Perhaps the best concept for slurry explosives in large operations is bulk handling, possibly by means of jobbers, in which the material is mixed in a plant and carried to boreholes in special containers which can conveniently be dumped directly into the borehole. In this way, the material might be properly formulated by gelling so that it can be dropped down through water without dissolving or without going apart, or handled in polyethylene bags.

During the past year methods have been developed making it possible to handle "flaked" TNT in field-mixing operations with little, if any, added hazard over AN-FO mixtures. For example, TNT may first be mixed dry with AN and SN to render the dry mixture effectively non-explosive. Another, perhaps still safer and more effective method, was recently described to the author by W. C. McLaughlin of the Anaconda Co., in which TNT is first covered completely with water and then added to dry AN-SN and guar gum mixture, the water needed to slurry the mixture being that carried into the mix along with TNT. In this way TNT is rendered relatively insensitive to either flammability or ignition by small booster action or by any sort of impact or friction. The cost of slurries is determined largely by the cost of TNT which comprises about 20 percent of the composition in the mixes used in open-pit blasting. While the coarse pelleted TNT is preferred, by using these special handling techniques, it is possible to use the somewhat less expensive flaked TNT. Moreover, there is considerable flaked TNT available from government sources at considerably reduced cost. It is desirable, therefore, to be able to use it in slurries directly without special pre-treatment. On the basis of government reclaimed TNT the slurry picture becomes particularly favorable economically, especially in view of the fact that large quantities of government reclaimed TNT are expected to continue to be made available from time to time.

It should be realized that there is a considerable potential savings in the use of slurries in hard rock blasting since drill costs are greatly reduced by the use of high density explosives, and explosives that develop very high pressures also reduce the secondary blasting and shovel costs by producing better fragmentation. This should be borne in mind in future developments of slurry explosives and in decisions by specific operators whether or not to try these mixtures in open-pit blasting.

Boosters For AN-FO And Slurry Explosives

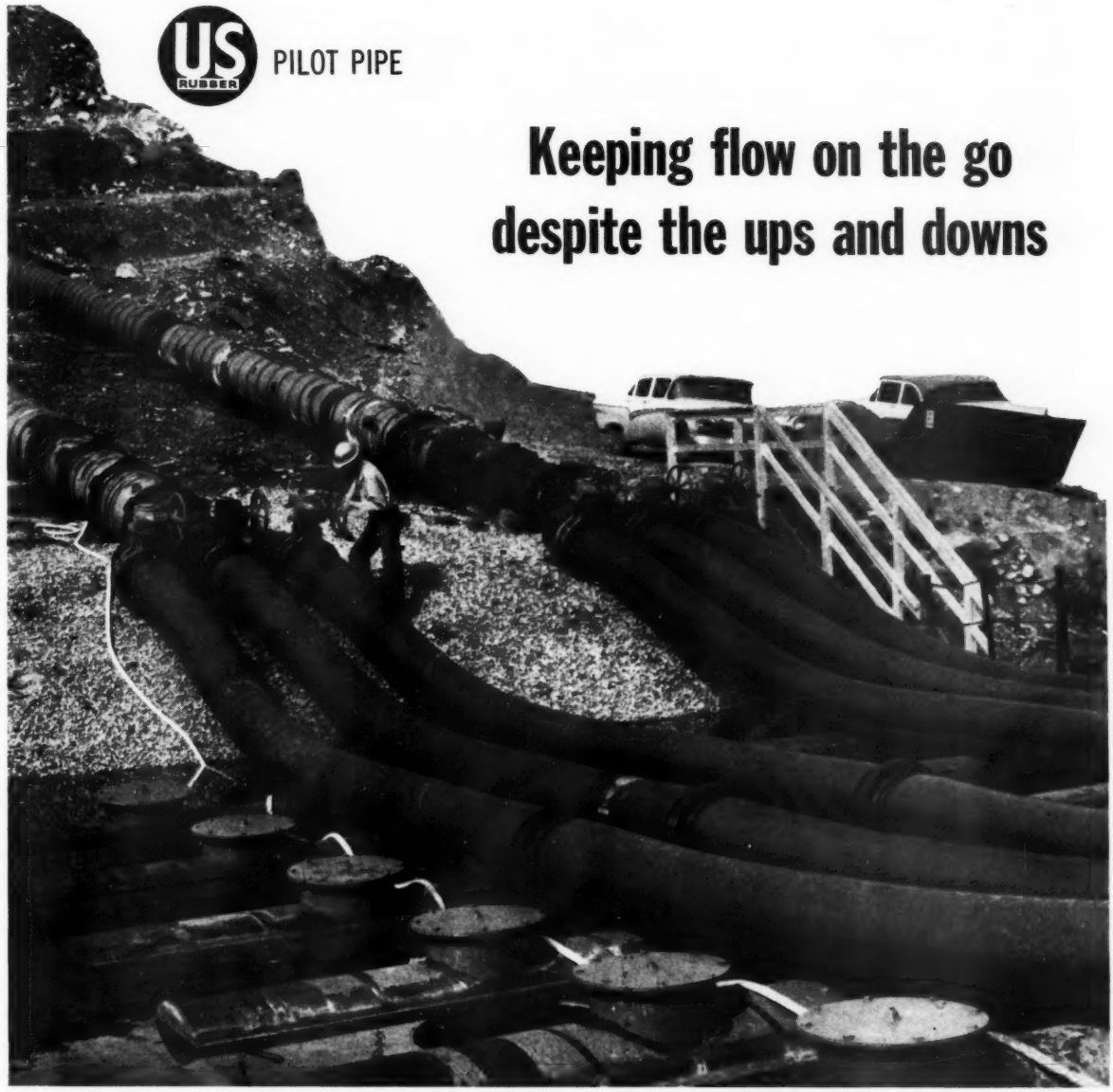
Boostering of "do-it-yourself" explosives has undergone a rather rapid recent development. At first, large quantities of dynamite and large "Nitramon" primers were used at frequent intervals in the borehole for detonation of AN-FO mitxures. For example, when the author first went to the Iron Ore Co. of Canada's Labrador-Quebec operation they were using 7 by 24-in. "Nitramon" primers, two in each 40-ft hole. A 160 gm cast 50/50 pentolite booster was introduced in place of the "Nitramon" primers and 10CC has used the pentlite boosters ever since with entirely satisfactory results. It is currently being manufactured by CIL under the trade name "Penta Mex". Many in the United States continue, however, to use dynamite boosters where the minimum booster cost is about $0.40 per hole using the minimum possible charge. For this reason there is some reluctance to go to the more costly, but much better high density, highly brisant, water resistant, cast pentolite and "Procore" type boosters which sell for half again to more than twice this price. It should be realized, however, that the cast boosters are far better boosters with much greater margin of safety as regards boostering action than say one lb of 75 percent gelatin dynamite.

Recently, the Intermountain Research and Engineering Co., Inc. of Salt Lake City, introduced the "Procore" #3C booster on the Mesabi

(Continued on page 107)

US RUBBER PILOT PIPE

Keeping flow on the go despite the ups and downs



A taconite mining company in Minnesota operates 365 days a year, has capacity to produce 7,500,000 tons of iron ore pellets a year.

To produce a ton of taconite pellets requires over 100 kwh of electric power and 25 tons of water. This plant, at its present production rate, pumps almost 65,000 gallons of water a minute. It is utilized so carefully that the make-up water requirement is held to less than 5,000 gallons a minute.

Two large diameter metal pipes lead from the barge pumping station to the concentrator. Three 16" U. S. Rubber Pilot® Pipe lines connect each pipe with the barge pumps. "U. S." Hose is used because due to rain or snow the barge may rise 7 feet or more, or sink as much as 10 feet, straining the hose and connectors.

U. S. Pilot Pipe is extremely flexible, yet very strong. Withstands up to 250 lbs. pressure, and extreme temperatures ranging to 45°F below zero. The plant cannot operate without water, hence "U. S." Hose is the *water lifeline*. Its dependability explains why U. S. Rubber is the world's largest manufacturer of industrial rubber products.

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DENVER AMC CONVENTION

The Mining Industry Viewed Its Problems From Every Angle

THE AMERICAN MINING CONGRESS' 1939 Metal Mining & Industrial Minerals Convention, which was held in Denver September 14–17, came up to the industry's highest expectations. Some 3000 persons from every part of the United States were present, including prominent legislators and Government officials, industry executives, operators, engineers, scientists and prospectors from all branches of metal mining and industrial minerals production together with a substantial number of coal mining men. Their common goal—to work towards solution of the industry's problem. In addition, as at all AMC conventions, numerous miners were present from outside the United States—Canada, Latin America, Europe, Asia, Australia, and Africa. All showed a high interest in the operating, economic and legislative problems of mining.

The session halls in the Brown Palace and Cosmopolitan Hotels were filled to capacity, with standing room only in some cases, as intent listeners turned out to absorb as much as possible of the information presented by more than a hundred well qualified speakers. The 18 convention sessions covered subjects ranging from Government policies affecting the industry to detailed operating techniques. Some five of these sessions dealt with broad basic matters of vital importance to the industry. Timely subjects such as national mineral policies, labor relations, taxation, the economic and technical outlook for the various

branches of the industry, public lands, and gold, silver and monetary problems were thoroughly aired by prominent leaders from industry and Government. Designed also for top executives were the sessions on management problems, safety, economic evaluation of proposed mining ventures, and uranium. A full schedule of technical operating sessions covering open-pit and underground practices and equipment, new developments in ore dressing, and general operating problems was arranged for men in production—managers, superintendents, engineers, foremen, miners and all other technical personnel. A brief resume of each session is presented later in this report.

AMC Declaration of Policy

The Resolutions Committee, headed by Kenneth C. Kellar of Lead, S. D., drew up and introduced during the convention a series of statements expressing in concise language the considered views of the industry on national policies which affect mining.

This policy declaration is one of the most important pieces of work accomplished at AMC conventions. It serves as a guide for the work of the American Mining Congress, and it gives wide publicity to the industry's problems and the policies needed to permit continued efficient operation.

The "planks" of the declaration were presented at appropriate sessions, and were endorsed without qualification by the convention. The full declaration as adopted follows on pages 68 to 74.

John C. Kinnear, Jr., new Chairman of the Western Division of the American Mining Congress

Welcoming Luncheon

Convention visitors received a warm welcome to Denver and to Colorado at a luncheon on Monday.

Mayor Richard Batterton of Denver voiced the city's welcome and predicted that the demand for most of the products of the mines is going to increase as the national economy and scientific achievement expand. He wished mining men well in their deliberations and urged them to return to Denver in future years.

Responding to Denver's hearty welcome, AMC President Raymond E. Salvati pointed out that the Mining Congress was founded in the Mile High City and was in effect celebrating a homecoming.

The sellout crowd at the Welcoming Luncheon observes the presentation of colors

He expressed the gratitude of mining men generally for the hospitality shown, and voiced the hope that the advice of those attending the Convention "will fall upon sympathetic ears in our national Congress and the Exeutive Departments, and will result in the adoption of policies which will strengthen our mineral position." He also expressed the appreciation of the industry for the support given it over the years by the distinguished Senators and Congressmen from Colorado.

C. J. Parkinson, vice president, The Anaconda Co., speaking for Program Committee Chairman E. I. Renouard who had been called to Butte by urgent matters, said "it is an honor for the American Mining Congress to meet in this great city of Denver and the magnificent State of Colorado." He complimented the city and the State for the fine hospitality and friendly reception.

Manufacturers Division Chairman William L. Wearly also praised Denver and Colorado for the fine hospitality extended. He made a special plea that all mining men at the Convention attend and participate in the technical meetings, saying, "these meetings will make possible an exchange of new ideas to further the technological improvement that will become tomorrow's accepted practices."

Following these responses, Western Division Chairman Cris Dobbins, who presided at the luncheon, introduced the members of Congress, Government officials, and directors of the Mining Congress who were seated at the head table.

The feature speaker at the luncheon was Governor Stephen L. R. McNichols of Colorado.

After voicing his pleasure at having the Mining Congress meet in his State, Governor McNichols expressed the opinion that the mining industry is on the threshhold of a great future, and urged mining men to cast aside their "burden of gloom" and prepare for an exciting future.

Governor McNichols, who recently visited Russia, called attention to the necessity of competing with that country in the markets of the world, in the classrooms and in our research laboratories. He said the mining industry should show the greatest concern for the welfare of the Free World and that it is in the front line in the world-wide economic battle of the 1960s.

An intent audience turned out to hear Senator McClellan's address on labor, Tuesday morning

He suggested a program for mining in which he called for an inventory of natural resources in the Free World, establishment of a "quota protection system" rather than high tariffs, and creation of a mining commission or agency composed of representatives of prospectors, miners, those supplying capital, research men, consumers, and mine labor. This commission, he said, could spearhead the inventory of natural resources, spur research and new uses for metals and minerals, and serve as a medium through which information as to technological, research and other advances in any branch of the mineral industries might be channeled.

Research Luncheon

As an innovation at AMC conventions, a special luncheon on Tuesday was devoted to the broad subject of research in the mining industry. John D. Bradley, president, The Bunker Hill Co., presided, and the principal address was given by David C. Minton, Jr., vice president, Battelle Memorial Institute. Speaking on "What Research Can Do for the Mining Industry," Minton discussed four avenues to the betterment of mineral economics through technical, economic, and market research. These he labeled (1) cost reduction, (2) by-product utilization, (3) diversification and integration, and (4) new uses.

Alluding to the work being done by the industry to secure governmental action to ameliorate its problems, Minton said that it is dangerous to put all our eggs in one basket. He pointed out that our industry has two major advantages over foreign competition—proximity to the world's greatest market and a superior technology. Through research, he said, we can whet these advantages to a keen edge, thereby achieving at least small increments in earnings that will help sustain operations during slumps and buoy profits when times are good. "Research may not be the whole answer for the mining and mineral industries," Minton concluded, "but it should be a big help."

Board of Governors Luncheon

The Board of Governors of the Western Division of the Mining Congress met at a luncheon on Wednesday, with Chairman Cris Dobbins presiding.

Members of the Board for the coming year, as nominated by various State mining organizations, were unanimously elected, and John C. Kinnear, Jr., general manager, Nevada Mines Division, Kennecott Copper Corp., was elected chairman of the Division for the coming year.

W. Howard Gray, mining attorney of Reno, expressed the pleasure of the State of Nevada that the 1960 Convention and Exposition are scheduled to be held in Las Vegas. He described the new Convention Center which is available for the meeting and promised that mining men can expect a warm welcome. The Board unani-

Highlight of the Ladies' program was a scenic trip to Granby

mously confirmed the meeting in Las Vegas, October 10–13, 1960.

Invitations were received to hold meetings in Seattle in 1961 and in San Francisco in 1962, as previously considered by the Board of Directors, and both were accepted. Further invitations were received to hold future meetings in Portland, Ore., and Los Angeles, and the Board instructed officials of the Mining Congress to study the proposed meeting sites and report back their findings in due course.

Brief remarks were made by President Raymond E. Salvati; Edward D. Tierney on behalf of Program Committee Chairman E. I. Renouard; and William L. Wearly, chairman of the AMC Manufacturers Division. Julian Conover spoke on behalf of the Resolutions Committee, expressing appreciation to Denver for acting as host to the meeting; to Cris Dobbins for his splendid service as Chairman of the Western Division; and to the many committee members and mining people of Colorado who worked so hard to make the Convention a complete success.

A highlight of the meeting was an address by Senator Thomas E. Martin of Iowa. Senator Martin declared that a strong domestic mining industry is needed to face up to the threat of Russia. He deplored the decline in the American mining industry and strongly defended the stockpiling of metals and minerals to meet any threat to our national security. The industry, he warned, must be constantly on guard against moves to dispose of stockpiled materials. "You in this room have the greatest power of any group in America to determine whether America survives in what Commodore Perry called that 'last, great, final battle'." He added, "if we keep ourselves alert and adequately prepared, industrially, economically, agriculturally, and defense-wise, we can prove Commodore Perry was a pessimist."

Secretaries' Breakfast

Twenty-five representatives of State and District mining associations met at breakfast Sunday morning prior to the convention, to discuss problems of mutual interest. Chairman of the meeting was Robert S. Palmer, executive vice president of the Colorado Mining Association. The group discussed the industry's current problems, including public land and mining laws, the Western Governors' Mining Advisory Council, and the great value of participation by responsible men from the mining industry in political matters.

Ladies Own Special Program

A large number of miners brought their wives to Denver, and while the men were busy at meetings and attending convention sessions the ladies were "running their own show." A train trip west through the Moffat Tunnel into the breathtaking Rockies provided magnificent views of unsurpassed mountain scenery. The train was "held up," and authentically garbed cowgirls and dance hall beauties took the ladies back into the 19th century West. They enjoyed a luncheon at El Monte Lodge at Granby where the townsfolk presented a program of western entertainment.

Next day the ladies gathered in the Lincoln Room at the Shirley-Savoy for a luncheon and a special showing of fall fashions by Neusteters of Denver.

With all this feminine activity, many fond wives found time in-between to attend the regular convention sessions—and, of course, they were on hand at the Welcoming Luncheon and the evening functions.

Evening Entertainment

No finer parties could have been anticipated than the Miners Jamboree at Elitch Gardens Monday even ng. and the "Speechless" Banquet at the City Auditorium Wednesday evening. The Jamboree, in an atmosphere of complete congeniality, got the lighter side of the convention off to a flying start. A fine steak dinner, excellent dance music and a top-flight floor show provided the ideal setting for mingling with old friends and getting acquainted with new ones.

Denverites could hardly recognize their City Auditorium when it was converted into a banquet hall and filled with enthusiastic miners for the climaxing social event of the convention. A fine dinner, interludes of music and dancing, and brief introductions of honor guests by toastmaster Alan Bible, U. S. Senator from Nevada, started off the memorable evening. Moving to the Auditorium Theater, the miners and their ladies enjoyed an extremely entertaining variety show, the last (official) stop was at the San Marco Room of the Brown Palace for dancing—which lasted until the early hours.

Trips

Always an important part of each convention, outstanding trips were arranged for Thursday, and many convention-goers took advantage of them. Foggy weather failed to dampen the ardor of the miners who trekked south to see the Air Force Academy, the most modern educational facility of its kind in the world. Lunch—chuck wagon style—was served at the scenic Garden of the Gods, and afterwards the group toured the surrounding area known for its unique Dakota sandstone formations.

Another group boarded buses headed for Climax, up on the continental divide, and were met there by officials of Climax Molybdenum Co., who gave brief talks and conducted a short "question and answer" period before treating them to an excellent lunch in the company mess hall. After lunch part of the group went underground and saw the new circular

(*Continued on page 74*)

AMERICAN MINING CONGRESS

A Declaration of Policy

Adopted at Denver, Colorado, September 14-16, 1959

UNDER our free enterprise system, aided by resourcefulness, initiative and inventive genius, the people of this Nation have created the highest standard of living of any country in the history of mankind. A strong, stable economy is essential if our system is to survive.

A strong, vital mining industry has in the past contributed immeasurably to the wealth and security of America. Farsighted Government action, at least in the past, has helped develop the mineral resources so necessary to the prosperity and the defense of this country. Today our resources are needed more than ever, both to support our own economy and to prevent any serious weakening of our Nation as a bulwark against aggression throughout the Free World.

Continued neglect of our mining industry would have grave and irreparable consequences in the future and would be little short of national suicide. Mining is a basic source of the strength of America.

The resolutions to follow call for a wise reappraisal of our resources, and a strong national policy for minerals, solid fuels and other natural resources.

NATIONAL MINERALS POLICY

The need for a National Minerals Policy has been evident for many years, but achievement has been painfully slow and discouraging. We have reached a critical stage where temporary expedients and half-way measures are not enough to maintain the mining industry in a healthy condition.

We endorse the provisions of recently enacted legislation which requests the President to review existing mineral programs for the purpose of providing increased production and employment in critically depressed segments of the mining industries; to advise the Congress at the earliest possible date as to remedial actions taken or proposed, and to submit to Congress a reorganization plan covering mineral activities within the Government and recommendations for administrative changes and legislation necessary to construct a wise and practical mineral policy.

The mining industry is ready to furnish technical advice, guide-posts and principles to help develop a National Minerals Policy and to put such a policy into effect. The major policies around which this industry will seek to cooperate and work with the Administration and the Congress are:

CONTROL OF IMPORTS

1. **Congress should re-establish and exercise its authority over tariffs. Adequate import duties or tariff protection, properly applied, are necessary to maintain many important segments of the domestic mining industry.**
2. **As to certain metals and minerals of which the United States produces a substantial portion of our domestic requirements, adequate import taxes should be established, to be imposed and collected only if and when the average monthly price falls below a reasonable prescribed point legislated for each metal and mineral respectively; thus providing a market free of any duty for foreign imports so long as the average monthly price is at or above the prescribed point.**
3. **When protection is accorded to any metal or mineral, such protection can become realistically effective only by establishing equivalent compensatory custom treatment on related metal or mineral items, including fabricated, semifabricated and derivative products.**
4. **Import quotas should be used only when no other adequate protection is practical and available.**
5. **As to those metals and minerals which are produced domestically sufficient only to provide a small percentage of our requirements, adequate programs in line with the circumstances in each case (such as allocation to domestic producers of duty collected from imports of the particular commodity) should be instituted and maintained to encourage continuance of such industries.**
6. **Provisions should be adopted by Congress to authorize escape-clause proceedings for all metals and minerals not now eligible therefor because of the technicality that duties thereon have not been reduced since 1934.**
7. **The Anti-Dumping Act of 1921 should be further strengthened and clarified.**

We would view with apprehension any modification of United States policy with respect to its traditional opposition to any arrangement for intergovernmental control of production of metals and minerals. We continue to object to any action by the United States to enter into intergovernmental commodity agreements. We do not, however, object to the United States joining committees and study groups set up by the United Nations, provided domestic industry representatives are appointed as advisors to the United States delegation, and provided that such participation does not foreclose or delay appropriate action in escape-clause cases.

STOCKPILING

The Nation's strategic and supplemental stockpiles must be available in times of national emergency. The stockpile goals, under the law, must be established on the basis that a healthy domestic mining industry be maintained on an active producing basis to supplement stockpile drawdowns. No withdrawals from strategic and supplemental stockpiles should be authorized except in a declared emergency when national security clearly requires release of a particular material.

Minerals, metals and alloys in the Defense Production Act inventory should be retained, or sold only under a plan formulated after consultation with representatives of the industry involved and with the appropriate committees of the House and Senate. Any such plan should provide for disposal only through domestic producers and in a manner and at such times that domestic prices and established markets will not be adversely affected.

The barter program should not be utilized to supply current Government mineral requirements nor to acquire minerals, metals or alloys for which stockpile objectives have been filled.

GOVERNMENT EXPENDITURES

Determined and effective action is needed to balance the budget. Federal governmental activity should not extend to those matters which the people themselves, through private enterprise or their local or State agencies, are able to carry out.

The Federal Government should refuse, during the period of high defense expenditures, to embark on new programs not of immediate necessity.

Economic disaster lies ahead if Government expenditures continue to exceed revenues. To prevent such disaster, the reduction of Government expenditures should be accompanied by a reduction of tax rates to a level which will increase the tax yield by stimulating economic activity.

TAXATION

The Nation's minerals must be made available to maintain the dynamic and expanding economy which is so vital to our general welfare and to all the people of the Free World. Finding and developing new reserves to replace those exhausted must be encouraged. The costs, the risks and the failures are constantly increasing. Profits, after taxes, must be adequate to furnish needed incentives if we are to have a continuing supply of the required minerals.

With respect to income taxation, it is essential that adequate depletion allowances be provided, at not less than present rates, and that gross income from mining be computed on a sound and reasonable basis. Depreciation and net loss carryovers should be fully and adequately allowed at not less than authorized by present provisions of the Internal Revenue Code.

In the case of State and local taxation, failure to grant an adequate depletion allowance, or failure to keep taxes within reasonable limits, will discourage the development of the mining industry and result in reduced revenues.

We commend Congress for its prompt action in limiting the power of the States to tax income derived from interstate commerce where such taxation constitutes an undue burden upon such commerce.

We particularly urge upon the Congress of the United States the following:

Exploration expenditures should be fully deductible and present limitations should be removed.

The excise tax on transactions in silver bullion should be repealed.

The present high income tax rates should be reduced to restore adequate incentive for investment risk, economic effort and initiative. Their reduction will benefit the economy and yield increased revenues to the Government.

The limited allowance now made to stockholders on dividends with respect to taxes paid by the corporation should be extended. The depletion allowed to a mining corporation should be carried through to the stockholder on an adequate and equitable basis. Intercorporate dividends should not be doubly taxed.

As a result of the past and continuing cheapening of the dollar, it is vital that our methods of computing taxable income be adjusted to avoid the confiscation of capital, to recognize continually increasing costs of replacing plant and equipment, and to recognize that most capital gains during periods of inflation of the dollar are a reflection of such inflation rather than taxable income.

The income tax laws of the United States should encourage the economic development of underdeveloped countries by private capital, rather than through the use of Government funds at the expense of our taxpayers. Where protection of domestic production against imports is necessary, it should be provided through import duties and other proper restrictions, rather than through extension of differential treatment in the income tax laws.

LABOR RELATIONS

We commend the 86th Congress for its recent action in the field of "labor reform" legislation. This action, in response to a widespread public demand and in defiance of grave political threats by the labor bosses, indicates that there is still a wholesome vitality in our system of representative government. We commend particularly those statesmen in Congress who, aware of their duty to the Nation to curb the growth of abuses and autocratic power within labor unions, fought so diligently and courageously against apparently insurmountable odds to bring about this constructive result. Likewise to be commended is the President of the United States for his major contribution to this remedial legislation. We are hopeful that the new legislation will accomplish the intended elimination of racketeering and corruption in the field of labor-management relations. Certainly it is a long stride in the right direction.

The hard fact remains, however, that the new legislation does not deal with the fundamental evil of labor monopoly power and the statutory sources of that power. Furthermore, the two "labor sweeteners" included in the new legislation must not be overlooked. Neither the provision authorizing an extension of compulsory unionism in the construction industry nor the provision giving replaced economic strikers the right to vote in representation elections are "labor reform" measures. These so-called non-controversial amendments to the Taft-Hartley Act are in fact additional weapons in the arsenal of labor monopoly power. They have been consistently opposed by the mining industry and they should be eliminated from the law.

The new legislation, except as just noted, deals principally with the problems of racketeering and corruption. Racketeering and corruption, both highly deplorable, are but symptoms of labor monopoly power. The far greater consequences of that sinister monopoly power are the economic enslavement of the industrial wage earners of America through coercion and compulsion, the undermining of the free enterprise system through successful exertion of inflationary pressures, and the increasing control of government through massive political expenditures. Human bondage, socialism, political domination, and corruption—these are the four horsemen of labor monopoly. All ride from the same stable.

Labor monopoly cannot be eliminated by piecemeal attacks on its results. Its sources must be uprooted. To this end we urge the Congress to give its continuing attention to this basic evil and to go forward with a program of further action including these additional essential elements:

1. **The elimination of the exemption of unions from the antitrust laws.**
2. **Prohibition of compulsory unionism in any form.**
3. **Removal of union immunity from injunctions in Federal courts.**
4. **Freedom from Federal compulsion in the procedures and subjects of collective bargaining.**
5. **Effective prohibition of mass picketing.**
6. **Effective prohibition of the use of union funds for political activity.**

The necessity for further legislative action designed to eliminate labor monopoly and its companion evils of compulsory unionism, compulsory bargaining, mass picketing and political action has long been urged by the mining industry. The recent action of Congress is encouraging but further action must be taken to protect our economy and the rights of individual citizens against the corrosive effects of labor bossism. The time has come when the special privileges and grants of immunity vouchsafed exclusively to the leaders of organized labor must be withdrawn. Union responsibility, including contract observance, is essential to proper labor-management relations.

To these principles and specific recommendations we rededicate our energies and pledge our support, to the end that our free economy shall flourish and the dignity and rights of the individual shall be preserved.

SOLID FUELS

The Nation's ability to meet the increasing energy demands of our expanding population and economy depends upon the efficient marshaling of its fuel and power resources.

Only through a planned, comprehensive program to conserve and properly utilize these resources can the United States meet the international challenge of today and the domestic energy challenge of tomorrow.

Recognizing the vital importance of coal as the primary energy fuel upon which the Nation can rely for centuries to come, we reaffirm the need for safeguarding coal productive capacity and a transportation industry which is at all times equipped to handle coal production.

We commend the foresight of coal operators, the United Mine Workers of America, coal-carrying railroads, electric utilities, and coal equipment manufacturers in their recent formation of the National Coal Policy Conference to achieve the aforesaid goals.

There is no better time to point out again that the availability factor for oil and gas quickly reaches the danger point in national emergencies. Natural gas is committed beyond its ability to meet emergency needs of war or unusually severe weather requirements.

We recommend and strongly endorse the following policies to assure fair consideration for the Nation's solid fuels industry and to protect the national interest and security:

1. **Establishment of a National Fuels Policy which will assure the sound economic position of the coal industry, bearing in mind its strategic indispensability in time of both peace and war. This policy should provide, among other things, for regular appraisals of the coal industry's capacity to meet the requirements of national security, current and projected, and to perform adequately its vital role in meeting national emergency needs.**
2. **Adoption of sound economic and conservation principles governing the sale and distribution of natural gas.**
3. **Continuation of existing mandatory restrictions on importation of crude petroleum and refined products, including residual fuel oil, with further reduction in the volume of imports of residual oil to the proportion which such imports bore to the domestic production of crude oil in 1954, as recommended by the President's Advisory Committee on Energy Supplies and Resources Policy in 1955.**
4. **Expansion by Government and industry of research to develop additional uses of coal, and establishment by the Federal Government of an independent coal research agency.**
5. **Increasing the percentage depletion rate for coal and lignite in recognition of the fact that the replacement cost of coal mines has greatly increased within the past few years.**

PUBLIC LANDS

Productivity and full utilization of the public lands should be a fundamental principle in the maintenance of our military strength and economic growth.

We oppose the closing of any area to mining location, either through creation of new withdrawals or maintenance of existing withdrawals, or otherwise, except in cases where it is clearly established that the purpose of such closing is more important to the national welfare than the full discovery and development of the Nation's mineral resources. We further oppose the continuation or extension of any withdrawal to any area in excess of that required to serve the particular purpose of the withdrawal.

We oppose enactment of any measure or establishment of any rule, regulation or determination of any executive agency which would preclude utilization of the mineral and other natural resources on the public domain, as being contrary to the public interest not only of the States directly affected but of the Nation.

The system established by the General Mining Laws for the location and patenting of mining claims has proven successful in encouraging and providing for development of the mineral resources of the public domain through private initiative and enterprise; however, in order to further encourage the use of modern exploratory techniques in the search for deep-lying minerals, we favor an amendment to the General Mining Laws which will afford reasonable pre-discovery protection to one who is in good faith engaged in exploratory work.

We commend the Department of the Interior and its Bureau of Land Management for its present application of the General Mining Laws in a manner consonant with the spirit and purpose of those laws and with recognition of long established principles as to what constitutes a sufficient discovery upon a mining claim. We believe, however, that great restraint should be exercised in respect to any holding that a mineral deposit is not a "valuable" mineral deposit or that it has no "economic value" where the claimant has expended and is willing to expend substantial sums in development of the deposit or in the development of the means or processes to put the deposit to use. The fact that value lies in potential as well as in present use has been clearly recognized in the case of our oil shale deposits.

We urge upon the Department of Agriculture and its Forest Service and the Department of the Interior and its Bureau of Land Management that their regulations be administered uniformly in order that the development of our natural resources may be prosecuted without undue burden.

MINE SAFETY

Mine safety will always be a major responsibility of the mining industry. The industry will continue to provide employees with safe and healthful working conditions, based upon the latest developed techniques for eliminating accidents and health hazards. Safety and health education will be of utmost importance, including particularly the training of supervisors and employees in safety and health programs.

We are firm in our belief that safety regulations should come from within the governmental structure of the States and not from Federal agencies. The United States Bureau of Mines is to be commended for its contribution to improved techniques in promoting safety education, accident elimination, and first aid and mine rescue training. We urge adequate support from the Government for the Bureau's work in these fields.

The steady improvement in safety records, as indicated by the decline in the number of fatalities and lost-time accidents each year, demonstrates the effectiveness of the industry's aggressive safety and health program.

WATER AND AIR POLLUTION

Water and air pollution problems, arising principally from urbanization, industrial growth, and transportation equipment, are related to individual area situations and are therefore essentially local in character. The nature and extent of air pollution are determined by local conditions and activities. The evaluation, the solution, and the control of such problems are therefore the responsibility and the right of the local and State jurisdictions of the affected areas. Where necessary, such local and State jurisdictions should function in cooperation with other jurisdictions to the extent dictated by the area encompassed in the problem.

In its consideration of grants-in-aid to the States for pollution control facilities, Congress should insure that State and local agencies administering the allocation of such grants retain full authority and responsibility to determine the financial and health needs of the communities, and to approve and supervise the distribution and use of such grants.

GOLD, SILVER AND MONETARY POLICY

Under the national monetary policies that have prevailed since 1934, the dollar—unredeemable domestically in gold—has declined to less than half its former value, while foreign dollar balances are still convertible into gold at $35 per ounce. Gold itself has thus been forced to accompany a depreciating paper currency in its decline in value—a procedure that will either demonstrate that gold is no longer the basic international monetary commodity, or that the dollar must be revalued in terms of gold.

The outflow of gold from the United States has already seriously reduced the national gold reserve. If the drain continues, a revaluation of the dollar may be forced upon us under circumstances that could be extremely harsh.

Increased production of gold from domestic sources would ease these conditions, but this could not be achieved without aid of some sort to the miners as costs in paper dollars rise. Unless the revaluation of the dollar in terms of gold occurs in the reasonably near future, the domestic industry, in the absence of special help, will become practically extinct.

Consumption of silver by the arts and industry and for coinage and other monetary purposes has far exceeded production for the past ten years. The production deficiency is currently being met by U. S. Treasury sales alone, which interfere with the normal operation of the law of supply and demand and impose a ceiling on the world price of silver.

We therefore recommend that:

1. **The restrictions on the purchase, ownership and sale of gold by United States citizens be abolished;**
2. **The Administration recognize the historical and traditional confidence in gold and silver as monetary metals throughout the world, and as part of its foreign policy aid other governments in restoring gold and silver coinage—and currencies convertible into gold—as a standard of value and as a circulating medium;**
3. **Congress fix the ratio at which the dollar and gold are to be made fully convertible and take all steps necessary to provide for the orderly restoration of the gold standard;**
4. **The Treasury, prior to restoration of full convertibility, cease sales of gold for industrial uses;**
5. **The Secretary of the Treasury, under the discretionary powers granted him by the Act of July 31, 1946, cease sales of silver at less than the monetary value and retain the Treasury's dwindling supply of free silver for future subsidiary coinage requirements; and**
6. **The Congress act to prevent the wasteful reduction of our silver stocks by immediately monetizing the presently held free silver and declaring inviolate the present monetary stocks, as well as insuring the supply of silver to our country by amending the Act of July 31, 1946 to eliminate the 30% seigniorage charge.**

URANIUM

Recognizing that a permanent, sound and stable domestic uranium industry is essential to the general welfare and security of the United States, we commend the U. S. Atomic Energy Commission for its efforts to balance its acquisition of source materials with present and future requirements. In future acquisitions, ability of the domestic uranium industry to meet domestic needs should be given full recognition and encouragement.

We urge upon the Atomic Energy Commission the following:

1. **No extension of present foreign source material contracts should be made, as domestic production is able to meet all projected uranium needs.**

2. **All source material contracts with domestic producers for the 1962-1966 period should be expedited.**

3. **All restrictions, except security licensing requirements, on sale of uranium concentrates to consumers other than the AEC should be removed in order to permit the development of a free market.**

4. **In formulating future policy, the AEC should take into account the fact that known reserves of uranium within the United States are limited. Such a policy, without violating security regulations, should indicate Government requirements of uranium after 1966, and should encourage long range exploration plans.**

5. **The price per pound for U_3O_8 during the 1962-1966 period should be escalated in line with increases in operating costs.**

6. **Under AEC encouragement numerous mines have developed ore reserves which today are without a market. We urge that the AEC take prompt action to provide a market for these reserves within its acquisition program.**

GOVERNMENT REORGANIZATION

We have strongly expressed our views on high costs of Government at all levels. We are discouraged by the long delay in enactment of laws to implement the recommendations of the Hoover Commission to increase the efficiency of the Federal Government by eliminating the overlapping of functions, by consolidating agencies, by transferring functions and responsibilities to the States, and by otherwise reorganizing the Executive Branch of the Government. We urge early resumption of serious consideration of the Hoover program.

U. S. GEOLOGICAL SURVEY—BUREAU OF MINES

The interest and activities of the United States Government in the mineral industry are centered in the Department of the Interior and its bureaus —the Geological Survey and the Bureau of Mines. These agencies are highly organized, with exceptionally well trained and highly competent scientists and engineers. Their official activities, including mapping and water resource studies, are very important to the mineral industry. We take pleasure in commending the personnel of these bureaus for the excellence of their scientific inquiries and their reports, and for their adherence to long-established practice and procedures under the laws concerning the mining industry.

We renew our recommendation that topographic and geologic mapping be accelerated and that water studies be given high priority in future budgets.

Any and all sound programs that propose transfer to the Interior Department of responsibilities affecting mineral resources but which are now carried by other agencies have our sincere endorsement.

MINE FINANCING

Commercial mining operations begin with the extraction of ores and minerals from the earth. The maintenance of our mining industry requires constant addition to established ore reserves by exploration, discovery and development of new deposits. Discovery and exploration and the development required to bring new discoveries into commercial production are possible only by the risk of venture capital.

There is no question that the raising of such capital should be done without misrepresentation of the prospect of success or misapplication of funds raised. Otherwise the mining industry as a whole is handicapped in obtaining required new capital. However, it is usually not possible, until after expenditure of very substantial sums, to say that a mining enterprise is established beyond the venture stage. The standards which may be applicable to investments in manufacturing or merchandising establishments are not entirely suitable for application to mining ventures, which necessarily are of different character. This essential difference has not received sufficient recognition.

We urge that all branches of Government, and particularly the Securities and Exchange Commission, recognize the practical objectives and circumstances incident to mine financing so that, in endeavoring to prevent abuses, whether real

or alleged, proper financing of mine enterprises will not be unduly discouraged, burdened or prevented. While we are sympathetic with the objectives of the Securities and Exchange Commission in seeking to prevent abuses of the privilege of levying and collecting assessments on the outstanding stock of corporations, we urge caution against the imposition of undue restrictions, or encroachment upon State laws. Closer scrutiny of the practices of assessable companies for the protection of stockholders and investors, if advisable, should be accomplished primarily through State legislation.

We are unalterably opposed to the Securities and Exchange Commission's proposed amendment to Form 8-K, Release No. 4089. This form calls for the reporting on a monthly basis of a broad range of information concerning financial transactions engaged in by corporations and intercompany financial arrangements involving officers and major stockholders. The proposal is an unwarranted administrative usurpation of legislative prerogatives and is in essence a "backstairs" enactment of so-called premerger notification legislation. The amendment demands much the same and even more information than called for by pending premerger legislation, to which we are also unalterably opposed since it would require corporations to delay normal business transactions because of a Government-imposed, prior-notice law.

MINING RADIO SERVICE

We commend the Federal Communications Commission for its efforts to alleviate congestion and interference in radio communications within the Special Industrial Radio Service. We are particularly gratified that the Commission will make available additional radio frequencies for mining and other industrial radio users in the microwave spectrum. We also wish to commend the program of voluntary frequency allocation for industrial radio, as conducted by the Special Industrial Radio Service Association, and we pledge our continued cooperation with this program.

We urge the Federal Communications Commission, in order to further relieve crowded conditions in the ever-growing industrial use of radio, to approve pending petitions of special industrial radio users which would:

1. **Add twenty-five frequency pairs in the 450-475 megacycle range for such users.**
2. **Reallocate the frequencies 49.54 and 49.58 megacycles to the Special Industrial Radio Service to permit use of the adjacent "split channels".**

The American Mining Congress, through its Radio Committee, stands ready to maintain liaison with the Federal Communications Commission, with other organizations in the mining industry interested in radio communications, with other users in the Special Industrial Radio Service, and with the newly-formed frequency advisory service, with the objective of protecting the interests of the entire mining industry and obtaining adoption of constructive communications policies which are so important to the safe and efficient operation of mining properties.

(*Continued from page 67*)
shaft which had been described at one of the operating sessions. Others went through the mill and surface areas and inspected the efficient beneficiation plant that has helped Climax become one of the finest operations in mining.

Spark Plugs and Motive Force

The outstanding success of the 1959 AMC Metal Mining and Industrial Minerals Convention is largely due to the efforts of those who worked diligently on the various committees. Cris Dobbins, president of Ideal Cement Co., was in charge of all arrangements. He was assisted by Albert E. Seep as vice chairman.

The Program Committee, under E. I. Renouard, worked hard and long to put together the top-notch policy and technical sessions for the meeting. Ben C. Essig was chairman of the Welcoming Committee, which represented the hospitable mining people of the host city of Denver. J. Price Briscoe was chairman of the Trips Committee, and the Publicity Committee, headed by Gerould A. Sabin, did a remarkable job of obtaining press, radio and television coverage. The Resolutions Committee, headed by Kenneth C. Kellar, and its several subcommittees produced the Declaration of Policy which sets forth the industry's position on important matters of national policy.

The Ladies Committee, whose efforts produced what many miners' wives called "the best ladies' program ever," was energetically led by Mrs. William T. Ahlborg. Serving in an advisory capacity were Mrs. Frank Coolbaugh, Mrs. Howard Crandell, Mrs. Cris Dobbins, Mrs. Ben C. Essig, Mrs. Albert E. Seep and Mrs. Merrill E. Shoup.

In 1960 it's Las Vegas—where the AMC Mining Show will be held from October 10 to 13. Las Vegas has built a fine new exhibit hall since the record-breaking 1955 Western Division convention was held there four years ago. The new show facilities and meeting halls are "built to order" for American Mining Congress convention needs, and from past experience we know that the hotels and entertainment available are outstanding—both as to quality and quantity. This is a meeting you shouldn't miss, so mark your calendar now and plan to be on hand at the 1960 AMC Metal Mining-Industrial Minerals Convention and Exposition next October.

THE CONVENTION PROGRAM

—a review of the sessions

Capacity crowds filled the meeting rooms to hear highly qualified men from industry and government present their economic views and technical observations on subjects of broad interest to the mining industry. A brief outline of each session follows

NATIONAL MINERAL POLICIES

THE session on National Mineral Policies was held Monday morning, September 14, with AMC President Raymond E. Salvati as chairman. High-ranking Government officials and leaders in Congress set forth their views as to what policies are needed to place the domestic mining industry on a sound footing.

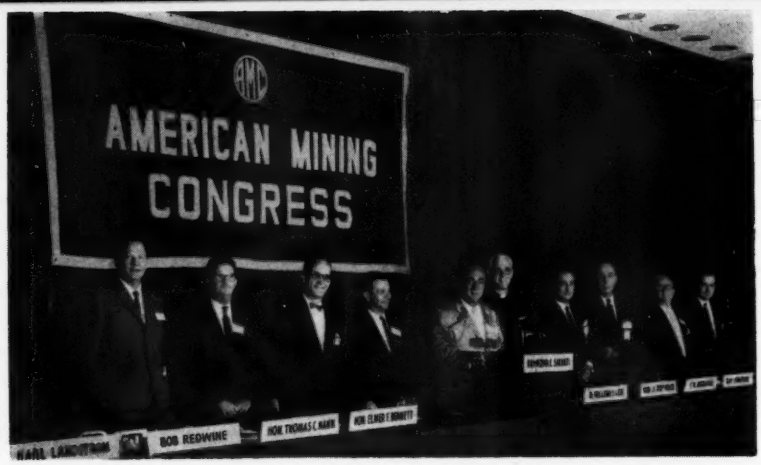
Under Secretary of Interior Elmer F. Bennett predicted a bright future for the mining industry. He said that by 1975 the growing needs of our expanding population will require 55 percent more metal ores, 250 percent more electric power and ever increasing quantities of fuels.

Bennett said that since the imposition of quotas on lead and zinc, domestic mine production of lead has increased 8 percent and zinc 24 percent. He also said consumption of the two metals had risen and that United Nations efforts to bring world production of lead and zinc into balance with demand are having "most promising" results.

The Interior official said his Department believed that enactment of the pending Allott bill (S. 1537) "will prove a long step forward in our efforts to promote the welfare of the minerals industries within the framework of the over-all national interest." He said that of all the economic and political developments which affect the minerals industries, the current fight against inflation and for a balanced budget is paramount. He urged mining men "to think hard and straight about the problems of inflation" and to exercise restraint and self-discipline in order that the free enterprise system may be maintained without imposition of onerous Government controls.

Discussing national stockpiling policies and their effect on the minerals industries, J. Roy Price, assistant director of the Office of Civil and Defense Mobilization, emphatically stated that his office "will resist all efforts to use the stockpile as a means for influencing prices or otherwise interfering with the normal operations of the economy." He declared that the sole objective for the stockpile is to meet any war contingency.

Price said that the present stra-



The views of high ranking Government officials and leaders in Congress were set forth at the National Mineral Policies session

tegic stockpile is considered to have about $3 billion worth of materials in excess of those needed to meet current stockpile objectives. Except for small quantities of metals and minerals not meeting quality standards, he said these are not now being disposed of since OCDM has not completed a study as to metal and mineral needs for any recovery period which might follow a nuclear attack on the United States. He indicated that it will be about another year before the requirements for such post-attack recovery will be determined.

Price called attention to proposed legislation which would divide the national stockpile, DPA metals inventories, the supplemental stockpile, Commodity Credit Corporation inventories and the GSA tin inventory into two accounts: (1) a strategic stockpile in which would be placed materials from any of the inventories which do not exceed stockpile goals, and (2) a reserve account containing all materials in excess of objectives. He expressed the thought that such legislation would permit more expeditious disposal of surplus materials while retaining safeguards against disruption of normal markets.

Assistant Secretary of State Thomas C. Mann reviewed the developments which led to the imposition of quotas on lead and zinc and declared that it is "too soon to make a definitive assessment of the effectiveness of our import program." He said there are four main reasons for not forming "hasty conclusions" in this regard: (1) it must be recognized that a level of imports which the mining industry may consider satisfactory may be prejudicial to other industries; (2) a level of imports which results in excessive lead and zinc prices brings about the displacement of lead and zinc by substitutes; (3) an unduly restrictive level of imports has the effect of making more difficult the task of controlling inflation; and (4) an excessive restriction on imports would also harm the economies of other countries.

Mann pointed to the efforts made to meet the problem of world oversupply of lead and zinc through international cooperation, and said it is still too early to say whether promises of lead and zinc importing countries to reduce production and sales will bring about satisfactory adjustments.

The current program of bartering surplus agricultural products for strategic products from abroad was outlined by Thomas R. Rawlings, director of the Barter and Stockpiling Division of the U. S. Department of Agriculture. He made it plain that the goal of the barter program is the disposal of surplus U. S. agricultural products and not the establishment of a metals and minerals procurement program "at the expense of the American farmer and the American taxpayer."

Rawlings dwelt at some length on the acceptance of materials produced or processed in the United States under barter contracts. He said the Department of Agriculture opposes the acquisition of domestically produced materials because it runs counter to the basic justification for the barter program. He said that when materials mined and processed in foreign countries are accepted under barter contracts, there is "concurrent creation of additional purchasing power in a foreign country which may be used to acquire additional quantities of U. S. agricultural commodities." On the other hand, he declared, "if materials produced in the United States were to be accepted under barter contracts, the supplier of these materials would have to pay dollars for them and in turn would have to recover his dollars through the sale abroad of the agricultural commodities given in exchange." He pointed out that the surplus agricultural commodities would thus be paid for with existing foreign purchasing power which would be available for purchase of these commodities whether or not there was any barter contract. He said the same argument applies, in a lesser degree, to domestic processing of foreign ores. He added that the present barter program permits domestic processing when agricultural commodities approximately equal in value to the exchange value of the processed materials being acquired will be exported to the source country of the raw material involved.

Congressional leaders followed these representatives of the Administration and all called for action to establish constructive national mineral policies. Some of them could not be present due to the delayed adjournment of Congress, but their papers were ably presented by members of Congressional staffs or leading mining men.

Senator James E. Murray, chairman of the Senate Interior Committee, in remarks presented by Robert Redwine, associate counsel of the Committee, deplored the lack of a workable national minerals policy and said that piecemeal proposals covering only a handful of minerals were a far cry from a long-range minerals program. He told the Convention that there is no single formula that will place the domestic mining industry on a stable basis. He suggested a minerals program as follows: (1) nationwide recognition that we must be as nearly self-sufficient in minerals as is possible; (2) in respect to those minerals where the U. S. has the capacity, coupled with adequate reserves to produce 40 or more percent of consumptive needs, import quotas be imposed at a level guaranteeing domestic producers at least their maximum historic share of the domestic market plus a proportionate share of future domestic consumption increases; (3) in respect to those minerals where U. S. capacity to produce is less than 40 percent of domestic consumption needs, tariffs be imposed at levels sufficient to sustain production of U. S. minerals at levels equal to their historic share of the American market plus a proportionate share of future domestic consumption increases; and (4) that materials in any Government stockpiles which may be declared surplus be disposed of only after consultation with Congress, and over a long period of time through regular producer trade channels. Murray declared that he will press for adoption

of these policies at the next session of Congress.

Another member of the Senate Interior Committee, Senator Gordon Allott of Colorado, was also unable to be on hand; his paper was read by Guy Emerson, president of the Denver Mining Club. Allott also decried the inadequacy of programs submitted by the Administration but declared that the "problem we face is not lack of support from the Administration but the difficulty arising because there is no Congressional directive."

He called attention to his measure, S. 1537, which would provide for a declaration of policy "that it is in the national interest for the Federal Government to foster and encourage an economically sound and stable domestic mining industry; the orderly development of domestic mineral resources and reserves" and research to promote the wise and efficient use of our mineral resources. The measure would require the Secretary of Interior to carry out this policy and to submit annual reports and recommendations to the Congress. It was passed by the Senate in the closing days of the last session and sent to the House.

Allott said enactment of the bill "will let our foreign friends know where we stand and what course we intend to pursue." He emphasized that its approval will place the world on notice that the United States intends to maintain, as a matter of policy, a strong vigorous domestic industry, and that it will no longer stand "idly by and permit imports to supplant, rather than supplement domestic production." He urged the mining industry to get behind his proposal and said "Once it is enacted, I intend to pursue vigorously the application of the Wool and Sugar Act principles to distressed mining industries, the Allott formula for assistance to smaller mines, and any other action program for specific minerals that is required by the situation as it then exists."

Chairman Wayne N. Aspinall of the House Interior Committee, in a statement read by Karl Landstrom, Clerk of the House committee, said that we do have a minerals policy of sorts. He said Congress has built into the Trade Agreements Act an escape clause designed to provide relief for industries suffering injury from excessive foreign competition. He stated that the President has consistently refused to effectively administer tariff relief to mining under the authority delegated to him by Congress.

R. W. Whitney spoke on the current status and future outlook for the iron ore industry

The House committee chairman said that the most significant mines and mining legislation in the past session of Congress is House Concurrent Resolution 177, which he introduced. The resolution points out that increased foreign production of certain metals and minerals, together with downward revision of stockpile requirements, have resulted in depressed domestic prices for minerals, drastic curtailment of production, economic disaster to many firms, hardships in dependent industries, extensive unemployment, and severe contraction of business in affected communities. He said the resolution, which has been approved by both Houses, establishes the basis for a positive and practical national minerals policy that "goes beyond mere platitudes and broad generalities." He pointed out that the keystone of the resolution is avoidance of critical dependence upon foreign materials and that its aim is "to awaken the Executive Branch to the need for prompt and sympathetic consideration of the real problems of the mining and minerals industry and for assistance to Congress in developing additional remedies and safeguards as may be necessary."

Rep. Ed Edmonson of Oklahoma, a member of the House Interior Committee, also came out strongly in support of the Aspinall resolution. He said it represents "the most significant policy declaration in our times by an American Congress on the subject of domestic mineral production" and declared that the Administration must now "fish or cut bait" to implement that policy. He said "we have waited a long time for the resolution's finding that a sound and stable domestic mining and mineral industry, without critical dependence upon foreign sources, is essential to national security and the welfare of the consuming public."

Edmondson pointed to the plight of the miners in the Tri-State area, and said that they have "finally been supplied with a deadline date for action."

He urged the mining industry to push hard for the implementation of the resolution. He said "we are going to have to get down to action and we are going to have to have a real concerted effort on the part of this industry to see that the action is implemented in the next session of Congress." He then added "I hope you will follow up the groundwork with the downfield blocking that will score a touchdown in the second session of the 86th Congress."

STATE OF THE MINING INDUSTRIES

CHAIRMAN of the Monday afternoon session on the State of the Mining Industries was Paul B. Jessup, secretary, Kennecott Copper Corp., New York City. He presided in the absence of the schedule chairman, Senator Henry Dworshak of Idaho, who was delayed by the late adjournment of Congress.

Jean Vuillequez, vice president, American Metal Climax, Inc., New York City, forecast that by 1970 the annual consumption of refined copper in the free world could well increase by about two million tons, or by more than 50 percent of present consumption. He also forecast that mine production capacity, expected to be 600,000 tons higher annually than present capacity by 1963, "appears to be keeping good pace" with projections of consumption through 1970.

In reviewing events affecting the hard-pressed domestic lead-zinc mining industry, C. E. Schwab, chairman, Emergency Lead-Zinc Committee, Washington, D. C., noted that some progress had been made in United Nations meetings in cutting world production and exports, "inadequate though we may have thought it to

be." He pointed out that, even after one year of import quotas on lead and zinc, "we are 85,000 tons shy of the goal of lead mining; we are 100,000 tons shy of the goal of zinc mining." Schwab added, "We are still a long way from the required combine price of 29¢ to 30¢ to sustain a sound domestic mining industry."

Iron ore supplies are ample at the present time, Richard W. Whitney, vice president, Hanna Mining Co., Cleveland, Ohio, reported. "Over the longer term," he said, "we're probably going to need a great deal of additional tonnage and will have to develop some entirely new deposits to provide raw materials for the iron and steel industry." He added, however, that most of the increased tonnage required during the next five years must come from sources now being operated or at least under active development, and outlined iron ore developments in this country, Canada, and overseas areas.

Ralph E. Knight, vice president, Kaiser Aluminum & Chemical Corp., Oakland, Calif., delivered an address on light metals prepared by D. A. Rhoades, president of the company. He said that consumption of magnesium in 1959 is expected to total 40,000 to 45,000 tons, a 20 percent increase over 1958. He added that many magnesium alloys have been developed since 1945, and that more than 30 basic magnesium alloys are now available in this country. With respect to aluminum, he said the industry has expanded its primary production capacity to three times that of nine years ago and that all elements of the industry are engaged in active programs leading to the development of new markets and the expansion of present markets.

Strategic metals were discussed by C. Hyde Lewis, president, New Idria Mining & Chemical Corp., Idria, Calif. Lewis said the current situation of producers is bleak, largely as the result of termination of Government purchase programs and contracts. After outlining the situation as to specific strategic metals, Lewis asserted that this country has finally adopted a policy of "leaving our minerals in the ground and relying on overseas sources which would not be available in times of emergency."

Walter F. Schulten, vice president, Consolidation Coal Co., Pittsburgh, Pa., said that the national security requires a bituminous coal industry whose annual productivity is 100 million tons or more above the 1958 level—a goal which is being promoted by the recently formed National Coal Policy Conference. He noted that many experts predict a bright future for coal, but added that "this will come to pass only if an enlightened fuel policy is adopted" by the Government. "Meanwhile," he declared, "the coal industry will make every effort to help itself by developing new uses for coal and continuing to improve productivity."

Many producers of industrial minerals probably will set new output records during 1959, Felix B. Shay, vice president, Foote Mineral Co., Paoli, Pa., reported. He said production and dollar value of these minerals are at their highest levels, citing as examples aggregates, cement, and structural clays. Demand for asbestos and gypsum, particularly for housing and commercial buildings, continues to increase, Shay declared, and new mines are coming into production in both the United States and Canada. He also asserted that the recent cancellation of work on boron aircraft fuels "should have little real effect upon this industry." This year should see an increase in phosphate production, he added.

Clyde L. Flynn, Jr., Independent Domestic Fluorspar Producers Association, Elizabethtown, Ill., said that sales by independent fluorspar producers to industry continue to decline in 1959, and that the price of the mineral has also declined. The downward price trend this year in the face of an upturn in consumption represents the effect of intensified competition between imported fluorspar and that which is domestically mined, he said. Flynn asserted that foreign producers "are now making their most determined effort to gain complete dominance of the domestic market."

UNDERGROUND MINING

ON Monday afternoon the first of two sessions on Underground Mining was presided over by Joseph C. Kieffer, manager, Northwestern Mining Dept., American Smelting & Refining Co., (and assisted by vice chairman), A. A. Ruoho, district manager, Phillips Petroleum Co.

William F. Distler, mine superintendent, Climax Molybdenum Co., described the shaft sinking job undertaken by his company at its main operation at Climax, Colo. The new shaft is circular, 19 ft in diameter, and when completed will be 700 ft deep. Conventioners who took the trip to Climax on Thursday were given the opportunity to see the new hoist, to inspect the progress in shaft sinking, and to talk with members of the shaft-sinking crews.

Another shaft sinking job, a 7½-ft, circular, concrete-lined shaft in the Riverton Wyoming uranium district, was described by Ken Nobs, district superintendent, Hidden Splendor Mining Co. He described in detail how the work was carried on. Four 10-in. holes were drilled near the proposed shaft location in order to get accurate logs of the ground structure, to check electrical resistivity logging and to lower the water table by deepwell pumping. Sinking costs totaled $146.85 per ft, exclusive of pre-sinking and pumping expense.

Mine mechanization in the east Tennessee zinc district was the subject of a talk by Johnson Crawford, assistant manager of mines, New Jersey Zinc Co. Crawford described the gradual evolution of mechanization in the district, pointing out that the greatest improvements in the mining efficiency have resulted principally from the development of drill jumbos and mechanical loading equipment. He cited his own company's Jefferson City mine as a good example of a recently developed property that has been designed to take fullest advantage of mechanization.

James R. Borden, mine superintendent, Union Carbide Nuclear Co., described in detail the uranium mining operations of his company on the Colorado plateau. The full text of his remarks appears in this issue beginning on page 94.

A review of recent activities of the Idarado Mining Co. at Ouray and Telluride, Colo., was presented by A. C. Hilander, general superintendent at Idarado. This paper showed how a company with a relatively low-grade ore body can, through the efforts of a cost-conscious and alert staff, continue in operation despite today's depressed metal prices and rising supply and equipment costs. Some of the means of keeping costs in line have been: centralizing working places, cutting back on nonproductive labor, introducing faster drilling equipment and lower grade explosives, improving maintenance programs, test work, redesigning mine and mill equipment, and a strict hiring procedure for improving employe quality.

Tuesday afternoon's session on Underground Mining was chairmanned by Eugene P. Reed, manager of Raw Materials, Tennessee Coal & Iron Division, U. S. Steel Corp. Vice Chairman was Claude O. Dale, assistant general manager, Mining & Smelting Division, Eagle-Picher Co.

John S. Rinehart, director of Min-

William F. Distler described the large underground circular shaft which was later inspected by convention-goers who took the trip to Climax

ing Research, Colorado School of Mines, discussed "Application of Principles of Rock Mechanics to Mine Planning." The science of rock mechanics, a rational physical description of how rocks behave under stresses, is in its infancy, according to Dr. Rinehart. Rock mechanics has never been utilized as the sole basis for the design of an operating mine, but ultimately mine design can be placed on the same scientific and engineering foundation that the design of buildings, highways, and bridges now enjoys. The transition will not and cannot be abrupt, he said, but the principles and facts which form the science of rock mechanics will contribute significantly to this transition —although specific applications may not yet be apparent.

Edward P. Leach, general manager, Mining Division, Bethlehem Steel Co., Inc., presented a first-hand account of "Mining Practices in Foreign Countries." During the past year a group of engineers from the Bethlehem Steel Co. and St. Joseph Lead Co. visited a number of European mining districts to study practices which might have application in the development of the new Pea Ridge iron mine in southeast Missouri. Leach discussed briefly current preferences, in a number of English, German, Dutch and Swedish mines, in regard to shafts, hoists, hoisting ropes, wire-rope guides and several new developments in mining equipment and practices which may find application in this country. He said that he and his colleagues were impressed with the high quality of engineering and planning that was evident throughout these foreign operations. Aggressive programs of research and experimentation are being carried out and are contributing substantially to the practices of mining and milling. Furthermore, he said, European operating men are well traveled and have ably adapted new developments, found anywhere in the world, to their own requirements.

Robert B. Jordan, chief engineer, Universal Atlas Cement Division, U. S. Steel Corp., described his company's modernization program at its gypsum mine at Clarence Center, N. Y. Present day competition necessitated improved economics through mechanization. The modernization program included mechanical loading, moving the crusher operation into the mine, replacement of track haulage system with belt conveyors and conversion from 25 to 60 cycle power. Of particular interest was Jordan's description of the Stubbe Faltenband, or Serpentix conveyor, which combines many of the features of a pan conveyor with those of a belt conveyor. This folded belt conveyor reportedly can convey up to a 40° slope and make turns in a horizontal plane. The Clarence Center installation is 250 ft long and inclined approximately 30° to the horizontal. Belt sections are 31½ in. wide and carry 150 tph at approximately 200 fpm.

The rest of the session was devoted to a panel discussion of roof support problems in heavy ground. The first paper considered "Applications of Hydraulic Fill," and was presented by John M. Suttie, mine superintendent, The Anaconda Co. His talk was based on experience at the Mountain Con mine in Butte, where hydraulic fill is the main means of support for stoping. Classified fill material of suitable percolation rate is secured from an old tailing pond, transported to the mine, and pumped through a four-in., rubber-lined pipe to the working areas underground. The stoping operation is based on fast extraction of horizontal cuts 10 to 12 ft high and 50 to 100 ft long, temporarily supporting the back and walls with rock bolts, then piping in sand fill. Tailing fill placed with water offers much greater resistance to compression than dry sand or waste rock and provides permanent support. Suttie concluded that hydraulic fill, due to its ready availability, its cheapness, varied applications, and excellent qualities as a filling medium, is an important means of support in heavy ground.

Charles L. Pillar, mine superintendent, San Manuel Copper Corp., in his paper "Placement and Use of Concrete Underground," stated that the use of monolithic concrete for the support of weak, heavy ground in large scale operations can show a major economic advantage over timber or steel supports. He said that concrete supports in raw, rock-bolted or lightly supported excavations are very satisfactory in respect to strength, permanency, ventilation, fireproofing, safety and cleanliness. Concrete's major economic advantage is a substantial reduction in the cost of maintaining openings in weak, heavy ground.

At the San Manuel mine, where ground weight pressures have been a major problem, approximately 4000 cu yd of concrete are being currently placed for ground support in the mining area every month. Pillar described the methods used in forming and placing the concrete and outlined its economic advantages.

"Rock Bolting in Heavy Ground" was covered by C. L. Gust, who presented a talk prepared by Clarence

New methods and mechanized equipment were discussed by leading operators at the underground mining sessions

The session on Milling and Metallurgy included topics on operating innovations, metallurgical research and beneficiation trends

N. Kravig, mine superintendent, Homestake Mining Co. At Homestake's Lead, S. D., operations, much heavy ground which formerly was timbered is now supported by rock bolts. Last year Homestake used over 43,000 bolts. Nearly all of the development headings and loose or broken ground can be supported with rock bolts used in conjunction with steel sheets, strips or wire mesh. Bolts are five, eight and ten ft in length, permitting anchorage above any natural arching tendency. "Perfo" bolts, or cemented pins, have proved to be effective where anchorage is a problem, but they are more expensive to install.

The final paper of the session was given by Wallace E. Crandall, chief engineer, Hecla Mining Co., who discussed "Yieldable Steel Rings." This type of support has been successfully used at Hecla's Silver Mountain Project in the Coeur d'Alene district to support a crosscut through an extremely heavy shear zone some 450 ft wide. Crandall described the sets in detail and told how they were put in place as the crosscut was advanced. Since completion of the job last August, he said, the ground pressure has gradually subsided, and these sets have held the ground with no further difficulty.

MILLING AND METALLURGY

FRANK W. McQuiston, Jr., chief metallurgist, Newmont Mining Corp., was chairman of a Monday afternoon session devoted to Milling and Metallurgy. Earl C. Herkenhoff, director of metallurgical research, Utah Construction & Mining Co., assisted him as vice chairman.

"Transportation of Concentrates in Pipelines at International Nickel's Creighton Concentrator" was the subject of a paper by D. A. Fraser, assistant mill superintendent, International Nickel Co. of Canada, Ltd. INCO pumps its Creighton Mill concentrates 7½ miles through wood-stave pipes using rubber-lined pumps at five different pumping stations. Original determination of pipe size to optimize service and minimize power consumption was the result of detailed test work described by Fraser. Information about trestle construction, pumps and pumping stations, and pipe specifications for the system, which has operated summer and winter since 1951, was given.

P. C. Good, supervisory chemist at the Albany, Ore., Metallurgy Research Center of the U. S. Bureau of Mines, spoke on Preparation of High Purity Metals. Good briefly outlined some activities of the Albany station in preparing extremely pure vanadium, thorium, zirconium, and tantalum by inert-atmosphere, high-vacuum and chloride metallurgy techniques. Utilization of these methods results in much higher costs per pound of product than in the usual milling and smelting operation.

John R. Moore, assistant general superintendent, Anaconda Reduction Department, Anaconda Co., presented a paper entitled "Automation at the Anaconda Mill." To offset increasing mill costs, the company's research department developed remote control systems for conveying and storing ores at the Anaconda mill and for feeding milk of lime into the concentrator circuit. Moore related details of specific equipment used to provide a more efficient and productive operation.

"Trends in Iron Ore Beneficiation" was the topic of a paper by Stephen E. Erickson, director of beneficiation, M. A. Hanna Co. He reviewed various new processes and procedures in iron ore beneficiation which are under test or active development. Two factors related to these developments, he said, are depletion of direct shipping or easily concentrated Mesabi ores and recent demands for higher quality blast furnace feed.

The Tuesday morning session on milling and metallurgy was presided over by Harvey Mathews, vice president, Stearns-Roger Manufacturing Co.

"Some Applications of Radioactive Isotopes in Metallurgical Research" was the title of a talk by Harold L. Gibbs, supervising metallurgist, Radiochemistry Research Program, and Adolph M. Poston, Jr., analytical research chemist, Analytical and Radiochemistry Laboratories, Salt Lake City Metallurgy Research Center, U. S. Bureau of Mines. Gibbs, who presented the paper, told how different radioisotopes and tracer methods have been used for solving problems in ion exchange, solvent extraction, chemical processing, volatilization studies and in analytical research. He mentioned several unique advantages of adopting tracer techniques, and dealt with other possibilities for applying radioactive methods in research.

Francis L. Holderreed, director of metallurgical research, and William Lucy, assistant research engineer, the Anaconda Co., collaborated in preparing a paper titled "X-Ray Analytical Methods in Process Control in the Anaconda Copper Concentrator." It was presented by Holderreed, who discussed how mill operators at Anaconda obtain instantaneous assays that furnish vital information in control of the flotation circuit. X-ray techniques used to continuously monitor mill pulps provide copper assays approximating those of conventional assays at concentrate levels of 22 to 32 percent, and bulk tailings at 0.10 to 0.25 percent. With closer metallurgical control over the process, increased concentrate grades at slightly improved recoveries are to be expected, he said. As a result of accepting the X-ray assay methods, the company can look forward to reduced direct labor and supply costs when compared with conventional chemical assay methods.

Pilot plant work with zinc ore from Pend Oreille Mines & Metals Co., indicates it to be amenable to treat-

ment by the amine process with about 81 percent recovery according to a paper jointly prepared by William F. Aitkenhead, director, and John A. Jaekel, associate metallurgist, Mining Experiment Station, Washington State University. Aitkenhead, who gave the talk, also discussed some interesting methods for flotation of autinite, uraninite, uranophane, monazite and chrysocolla.

Arthur W. Last, chief of the ore dressing section at Kennecott Research center presented a talk on The Leach-Precipitation-Flotation-Process at Kennecott's Ray Concentrator. His full text is carried as an article on page 108 of this issue.

Performance of the Kermac Solvent Extraction Plant in the Ambrosia Lake District was discussed by Wayne C. Hazen, senior research engineer, Kerr-McGee Oil Industries. Kermac's 3630 tpd uranium mill at Grants, N. M., probably represents the largest scale application of solvent extraction in the mineral industry. Two years of study and operation of a one tpd pilot plant led to selection of an acid leaching circuit mill, various phases of which Hazen described in detail.

LABOR RELATIONS

TUESDAY morning's Labor Relations session featured an inspiring address by U. S. Senator John L. McClellan of Arkansas, chairman of the Senate "Rackets" Committee and one of the architects of the new labor reform law. He was introduced to a standing-room-only audience by Kenneth C. Kellar, chief counsel, Homestake Mining Co., the session chairman.

Senator McClellan reviewed developments leading to the enactment earlier in September of the new labor law, which he said "beyond all question represents the major legislative product of the first session of the 86th Congress." He briefly outlined the law's provisions, including the Bill of Rights—"truly a Magna Carta for the rank-and-file union members of this country." He also declared that, if this law proves insufficient to stop the organizing of a combination of transportation unions in restraint of trade, "there's only one alternative. That's to put the transportation unions in the country under the anti-trust laws. Hoffa or no one else must be permitted to rise above the power and beyond the reach of the Government itself!" [Editor's note: Senator McClellan's address will be published in full in the November issue of Mining Congress Journal.]

Frank N. Price, Industrial Relations Director, Ideal Cement Co., Denver, spoke on Labor Relations in his company's operations. He related how by encouraging a high degree of friendly and cooperative relationships between management, employees and their representatives at all levels of responsibility, the Ideal Cement Co. has achieved what he termed "some measure of success in labor relations."

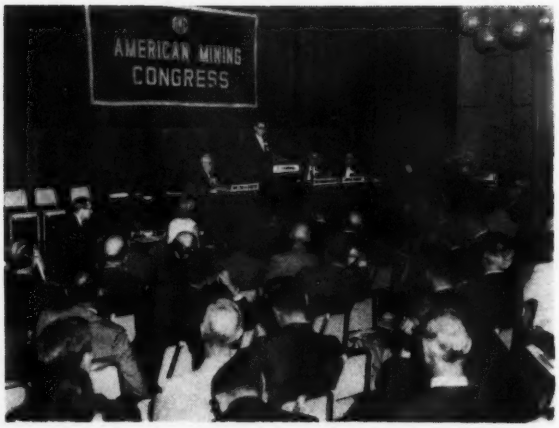
A standing-room-only audience was present to hear talks on labor relations by Senator McClellan and Frank N. Price

Price said that from the beginning of the company's formalized labor relations program "we have operated under the basic belief that any such program must give due consideration to the rights and proper interest of the company, its employees and all others affected by the activities of the company." He said his company maintains programs to provide a job evaluation plan based on industry practices, a healthy working environment, application of tested and proven accident prevention methods, and careful observation by management and employees of the spirit and intent of negotiated labor contracts. He added that supervisory training programs also are aimed at developing proper attitudes towards a real understanding of labor relations. He emphasized that as long as employees organize, the issues of negotiation and administration of labor agreements will have to be met and "our skill and ability in the handling of these matters will determine the course of our labor relations."

ECONOMIC EVALUATION OF PROPOSED VENTURES—A SYMPOSIUM

AS a departure from the conventional papers on exploration and geology, this year's meeting featured a symposium on Economic Evaluation of Proposed Mining Ventures, with E. H. Crabtree, director, Colo-

Important aspects of developing a mining enterprise were treated at the session on economic evaluation of proposed mining ventures



Speakers at the Tax Panel discussed the tax problems of the mineral industry—particularly as they relate to our nation's ability to produce the vital raw materials needed for national security

rado School of Mines Research Foundation, Inc., as chairman and Richard J. Lund, assistant technical director, Battelle Memorial Institute, as vice chairman.

Introductory remarks were made by Fred L. Smith, manager of Mining Division, Colorado School of Mines Research Foundation, Inc., who pointed out that it is no longer sufficient to merely find and explore an ore body and come up with a quantitative calculation of ore reserves. A number of specialists are required to determine the true earning potential of any mining venture which, in the final analysis, is the basic concern of the investors and mining company managements, he said.

The first speciality, "Exploration, Geology and Ore Reserves," was covered by Evan Just, Head, Department of Mineral Engineering, School of Mineral Sciences, Stanford University. He discussed the many reasons why a company may or may not want to undertake detailed exploration work in a particular area, and outlined appropriate procedures for conducting an exploration. In addition, Just pointed out some of the many "pitfalls" which must be guarded against by exploration men. In closing he urged business groups who wish to find mines to be prepared to gamble beyond the point suggested by their traditions and to expect many disappointments before a real prize is brought home.

John W. Chandler, mining engineer, American Metal Climax, Inc., presented a talk on "Mine Development and Mine Operating Costs" as required in setting up the economics for a new enterprise. He discussed the factors involved in arriving at optimum output and showed how costs are broken down into their various elements. He explained further how mechanization and modern mining techniques must be taken into account in selecting the mining method and laying out mining plans for any new venture.

The critical step of selecting the best treatment process for a prospective mineral operation was analyzed by John A. Riddle, metallurgical engineer, Union Carbide Nuclear Co. He said that flow sheets for proposed processes must be drawn up as completely as possible and discussed several methods for estimating capital and operating costs.

Wilbur Jurden, president, Anaconda-Jurden Associates, described the chief considerations for estimating, on both a preliminary and final basis, the cost of construction of any and all facilities for a new mining venture. Jurden stressed the need—after the final estimate is completed and the project authorized—for adequate controls over the design, purchasing and construction in order that the project will be completed within the estimated cost and scheduled time. He pointed out that the ultimate cost and adherence to a time schedule are of far more interest to company officials and financiers than are any of the other multitudinous details involved.

In his paper, "Financial Projections to Determine Economic Feasibility," A. Bruce Matthews, partner, Arthur Andersen & Co., discussed the role of the accountant as a member of the team which brings a new mining venture into being. He urged careful analysis of the economics of all proposed ventures and observed that successful financing is dependent upon sound analysis and effective presentation.

Thomas F. Creamer, vice president, First National City Bank of New York, told what a commercial bank looks for in considering participation in the financing of a mining venture, including financial statements and the competence of the company's management. He reviewed typical types of commercial bank loans, giving examples of each type in which a commercial bank has participated in financing mining companies, and covered the importance of a feasibility report prepared by competent engineering consultants. Particularly emphasized was the need of proven ability of any company before a commercial bank will participate in financing a new venture.

TAXATION

SENATOR Thomas E. Martin of Iowa presided over the Tax Panel Tuesday afternoon. In opening the session he said that the general objective of the forthcoming Ways and Means Committee hearings—broadening the tax base in order to permit reduction in general tax rates—is desirable, because "taxes cannot be increased without stifling our economic growth." However, Senator Martin stated, equality of taxation is desirable only where there is identity of circumstances, and "the Nation can ill afford to reduce its supply of minerals by failure to take into account the special problems of the wasting asset industries."

Rep. Howard H. Baker of Tennessee, a member of the Ways and Means Committee, discussed the Treasury Department's request for legislation defining "cut-off points" for gross income from mining for the purpose of computing the percentage depletion allowance. Stressing the importance of continuing the percentage depletion concept "on a sound and reasonable basis," he expressed the view that if the cut-off point problems are not settled satisfactorily, many members of Congress will want to reconsider whether particular minerals are entitled to percentage depletion allowances and, if so, at what rate. Baker suggested that the industry be prepared to offer advice and assistance to the Ways and Means Committee in handling cut-off point legislation, because of the vast number of technical problems involved. He said that cut-off point legislation next year may not be confined to clay and cement, but that he believes those two should be the subject of separate legislation. He further took the position that the rights of clay and cement producers have been sufficiently established under the present law so that Congress should put an end to the protracted litigation over past years by legislation specifically confirming the court decisions.

Baker also discussed his bill, H.R.

4251, to liberalize the deduction for exploration expenditures. He said that the Ways and Means Committee insisted on reducing the benefits of the bill as introduced, but that the Senate Finance Committee might be persuaded to restore the original provisions, and allow a deduction of $100,000 a year for exploration expenditures—expenditures which Baker asserted are "the life blood of the mining industry."

L. J. Randall, President, Hecla Mining Co., discussed his views as to why the percentage depletion allowance is an equitable and vital part of our tax structure. They were received with particular interest because he is one of the expert witnesses invited to appear before the Ways and Means Committee in the December hearings on "broadening the tax base."

E. C. Alvord, AMC Tax Counsel, was unable to be present, but his views on the current outlook on taxes and the national economy were presented by Lincoln Arnold, chairman of the AMC Tax Committee.

GOLD, SILVER AND MONETARY POLICIES

THE Tuesday afternoon session on Gold, Silver and Monetary Policies was presided over by co-chairman Donald H. McLaughlin, president, Homestake Mining Co., and John Edgar, general manager, Mining Division, Sunshine Mining Co. McLaughlin asserted that present U. S. policies on gold mean inflation at home, with a depreciating dollar, while at the same time we are forced to try to sell goods abroad in dollars which are backed by gold on the old basis of $35 an ounce. He said we have prevented a run on gold domestically by laws preventing conversion of paper dollars into gold, while we are inviting a run on gold abroad by standing ready to convert dollars held by foreigners into gold. He observed that the Treasury has quick, short-term gold liabilities of $18 billion, while our stock of gold has decreased to about $19.6 billion. McLaughlin foresaw two alternatives—complete repudiation of gold as a basic monetary material, or revaluation of the dollar in terms of gold. He forecast that the international value of gold will prevail in the end, with revaluation of the dollar. He emphasized that the traditional AMC policy is the one which the country should be following—restoration of the gold standard with full convertibility of the dollar, accompanied by revaluation of the dollar in terms of gold.

Senator Alan Bible of Nevada reviewed the monetary policies of the Nation, directing particular criticism to the abandonment of silver as a standard of value. He pointed out that these policies have reduced the silver industry to a point where total production today is less than $40 million annually—"less than half the sales of a single chewing gum manufacturer." He said this "mismanagement" has not only destroyed the silver industry, but has been extremely damaging to the Nation's economy as a whole. Senator Bible expressed the belief that the country should discontinue Treasury sales of silver from the general fund, and release silver only at the statutory price, through redemption of silver certificates. Further, he stated, Congress should eliminate the present seigniorage of 30 percent and allow domestic producers to deliver newly mined silver to the Treasury at the statutory price of $1.2929 per ounce.

Clark L. Wilson, vice president, New Park Mining Co., reviewed the growing industrial demands for silver. He pointed out that annual U. S. production for the past seven years has averaged 37 million ounces, while U. S. consumption during the same period has averaged 135 million ounces. He said the same trend is shown by world production and consumption, and concluded that the silver supply will soon be exhausted if present trends continue. When that happens, Wilson stated, the Treasury will be forced into the market for the added silver needed, with the probable consequence of higher costs to the Treasury. Like Senator Bible, Wilson advocated elimination of the seigniorage charge and cessation of sales of "free silver."

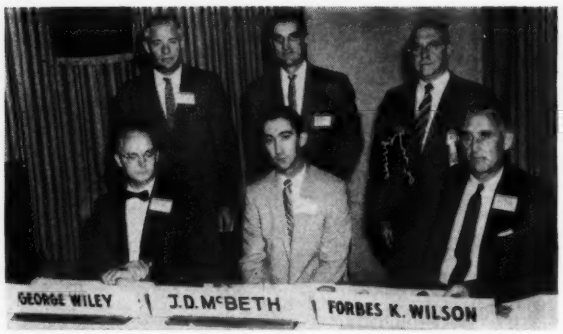
OPEN PIT MINING

GLOYD M. Wiles, manager, Mining Department, National Lead Co., was chairman of the Tuesday afternoon session on Open Pit Mining. Vice Chairman was R. P. Hughes, mechanical superintendent, Miami Copper Co.

The first talk entitled "Ideal's 5½-Mile Overland Belt Conveyor Installation," was presented by George Wiley, chief engineer, Ideal Cement Co. He described a newly installed $3,000,000 conveyor system designed to transport limestone and shale at 500 fpm from the Lawrence quarry crushing plant to the company's new 3,000,000 bbl cement plant at Ada, Okla., 5½ miles away. The 36-in. wide conveyor consists of seven flights, one of which is 11,766 ft long and is reportedly the longest permanently installed belt conveyor in the world. The belt conveyor system is fully protected with devices which stop it in the event of belt slip, drift, chute overloading or actual belt damage.

J. R. Kringel, vice president-production, New York Trap Rock Co., spoke on "Control of Air Blast Effect Resulting from Blasting Operations." He told of some of the problems his company has experienced resulting from conducting large-scale blasting operations in thickly settled areas. Since there is widespread misunderstanding among both laymen and op-

Donald McLaughlin forecast, "The international value of gold will prevail in the end"



The two open-pit sessions covered everything from giant trucks to the latest data in ammonium nitrate explosives

erators concerning blasting effects, he stated, it is not surprising that complaints and litigation sometimes follow a large blast. One remedy, he said, is the ability to recognize various atmospheric conditions which are not favorable for firing. He went on to relate the findings of his company in a detailed study.

"Skip Hoisting at Kennecott's Nevada Mines Division" was the title of a paper by Frank Quilici, pit superintendent, Nevada Mines Division, Kennecott Copper Corp. In his absence, J. D. McBeth, general pit foreman, described the system devised to replace rail haulage as the pit was expanded and deeper ore was mined. Detailed study had revealed that a truck haulage-skip hoisting system offered numerous advantages that would increase production and reduce costs. Conversion of the pit from rail haulage and installation of the skip were also covered.

Forbes K. Wilson, vice president, Freeport Sulphur Co., described his company's nickel-cobalt operation at Moa Bay, Cuba. After commencement of exploration work in 1952, Freeport embarked on a long range plan to develop and mine 50,000,000 tons of lateritic nickel deposits that occur as a surface mantle of soil varying 10 to 100 ft in thickness. Mined material is screened and washed; plus 20 mesh material is slurried, acidified and subjected to heat and pressure in autoclaves to dissolve the nickel and cobalt. After thickening, clarified solutions are treated with hydrogen sulphide to precipitate sulphide concentrate containing about 55 percent nickel and five percent cobalt.

Under the chairmanship of Alfred T. Barr, manager, New Cornelia Branch, Phelps Dodge Corp., a second open pit mining session was held on Wednesday morning. John D. Boentje, Jr., vice president and general manager, Pacific Isle Mining Co., served as vice chairman.

In considering "Slope Stabilization in Open Pit Mining," Stanley D. Wilson, Shannon & Wilson, Engineers, pointed out that in the field of soil mechanics it has been found that most slope failures are the result of water pressure behind the slope face. Wilson has come to the same conclusion with regard to slopes in open pit mines, particularly in fractured and fissured rock. It follows then that slope stabilization may be reduced to the basic problem of relieving the excess water pressure by means of subsurface drainage. Unfortunately, this is as difficult in practical applications as it is simple in concept. First, it must be verified that excess water pressure is present; second, the unique combinations of topography, stratification and faulting which collected the water and concentrated the seepage paths leading to the cut slope must be detected and analyzed, and third, a feasible and economical method of relieving the excess pressures must be devised.

Robert E. Kendall, assistant mine superintendent, U. S. Borax & Chemical Corp., presented a paper on "The Bucket Wheel Excavator and Belt Conveyor—Germany's Solution to Low Cost Dirt Moving." His inspection of the German lignite mines revealed that (1) conveyor belt transportation is rapidly supplanting the traditional rail haulage for both coal and overburden; (2) wheel excavators range in size from one-man rigs at 200 tph to giants capable of digging 130,000 yd per day from a 150-ft high face, and (3) you have to throw away the book on conveyor practice. Kendall said that the Germans are running miles of belts at from 8 to 1200 fpm. They gave up the 20° troughing idler in favor of the 30° idler years ago and their transfer point design is constantly improving. They can move a 2000-ft long conveyor, 200 ft closer to the pit face and have it running again in eight hours. The Germans have conveyors mounted on crawlers that serve as a flexible link between the excavator and the belt system, and they have made the conveyor system flexible enough to follow a continuously moving excavator.

O. E. Pothier, director of mining operations, J. R. Simplot Co., spoke on "Western Phosphate Mining." The deposits in the West are in Idaho, Montana, Utah and Wyoming, and are reported to contain over 60 percent of the Nation's reserves. These deposits have been known for over 60 years, but it has been only in the last 15 years that widespread interest has been shown in them. Since World War II, production has increased from a few hundred thousand tons to 2,500,000 tons in 1958. Pothier described the operations of the J. R. Simplot Co., which is operating what is now the largest open pit phosphate mine in the West. The company mines over 1,000,000 tons each year from open pits using rubber-tired single-engine and twin-engine scrapers, 2½-yd shovels, 17-ton end-dump trucks and 26 and 40-ton bottom-dump wagons and the necessary supporting equipment. Faulting and local grade changes of the ore beds require careful mining control. To accomplish this, complete records are maintained. Much of the low cost ore has been mined, but open pit reserves are large. Increasing attention is being given to beneficiation to extend reserves. Pothier concluded that the phosphate business, in the West, is still in its infancy.

Melvin A. Cook, professor of Metallurgy and director, Institute of Metals & Explosives Research, University of Utah, presented an up-to-the-minute report on "Ammonium Nitrate Explosives." He said that the most significant recent developments in the ammonium nitrate (AN)-fuel oil (FO) system include (1) clarification of the influence of the surface active, long hydrocarbon-chain coatings as compared with the kieselguhr coating for the prilled ammonium nitrate, (2) methods of improving density, velocity, and borehole pres-

sure in the AN-FO types, (3) developments of new, higher density AN types for use with fuel oil, and (4) the development of new improved boosters for this and other relatively insensitive, open-pit AN explosives. Cook discussed these developments fully, and went on to describe field-mixed and plant-package slurry explosives, noting that formulation of slurries suitable for use in small diameter, underground operations is being studied.

The final paper of the session, entitled, "Large Truck Haulage at Eagle Mountain," was presented by Martin J. Hughes, mine manager, Kaiser Steel Corp. He discussed in detail the haulage equipment used for the daily production of 68,000 tons of open-pit material. Three types of trucks are used: 22-ton end dump, 36-ton end dump and 64-ton semi-trailer end dump. The 64-ton units are being used primarily for the handling of waste. However, it is often necessary to use them for hauling ore up the adverse grades to the crusher. Also, waste must often be hauled both up and down on grades of from 10–12 percent. During the year 1958, the cost of hauling with 36-ton trucks was 87.9 percent of the cost of hauling with 22-ton trucks, and the cost of hauling with 64-ton trucks was 68.8 percent of the cost of hauling with 22-ton trucks. Hughes concluded that although the 64-ton truck is doing an excellent job, it is not the ultimate, and as expansion occurs, every effort will be made to obtain bigger and more efficient trucks for the large-scale movement of ore and waste from the pit.

PUBLIC LANDS PROBLEMS

REP. J. Edgar Chenoweth of Colorado presided at a Wednesday morning session on public lands problems, which featured a discussion of proposed legislation to establish a National Wilderness Preservation System.

The session on public lands problems featured a discussion of the National Wilderness Bill

W. D. Hagenstein, executive vice president, Industrial Forestry Association, Portland, Ore., chronologically outlined developments since introduction of the first Wilderness bill in 1956, including arguments pro and con. He concluded that the question is, "How much [wilderness] can we stand and still discharge our responsibilities for more jobs, secure payrolls, and more things for better living for our rapidly increasing population?" He added, "Jobs for the many or wilderness for the few?"

W. Howard Gray, Reno, Nev., attorney, who is chairman of the AMC Public Lands Committee, supported the principle of multiple use of public lands. "To lock up a piece of territory and throw the key away so that no one can go in there to find out what resources lie beneath the surface," he asserted, "is a short-sighted, uneconomic approach to the problem of supplying the necessary products for the advancement and maintenance of our economic well-being and our civilization."

Rep. Al Ullman of Oregon, a member of the National Outdoor Recreation Resources Review Commission, said that he thinks this Commission should set up a basic policy with respect to wilderness and that Congress should be guided accordingly. The Commission must submit its findings to Congress in 1961, he said, and if Congress should act on wilderness legislation prior to that time, he thinks its action should be temporary pending the outcome of the Commission's findings. Ullman also urged continued support of the concept of multiple use of public lands.

Former Senator Frank A. Barrett of Wyoming, now general counsel of the U. S. Department of Agriculture, reported on the Forest Service's administration of the multiple-use laws pertaining to public lands. He paid tribute to the mining industry for supporting enactment of these laws, which he said made possible "the fullest practicable development of the

Large crowds attended the technical sessions to get the answers to their operating problems

mineral resources on the public lands." He concluded, "Our western States can grow and develop only under a policy of wise use of our natural resources through a sound multiple-purpose use system."

George Abbott, solicitor, Department of the Interior, also reported on administration of multiple-use public land laws. He noted, in connection with a 1954 law permitting concurrent mining and oil or gas activity on the same public land areas, that the Department is convinced that it is working well. "We are convinced too," he added, "that by reason of its enactment the prospects of fuller and wiser utilization and development of all of the mineral resources of the public lands have been assuredly and immeasurably enhanced."

VIEWPOINTS ON SAFETY

A WEDNESDAY morning session devoted to exploring safety viewpoints of mining men, from the miner on through to top management was under the chairmanship of Frank Coolbaugh, president, Climax Molybdenum Co.

What Safety Means to the Miner was discussed by John Perkovich, a miner from Homestake Mining Co. He remarked that Homestake's mine department recently received second place in a national safety competition as a result of co-operation between management and workmen. Some of the reasons why the company has been able to show a decline in accident rate were covered.

Donald E. Wilson, division mine foreman, Bunker Hill Co. told his audience that "Getting the Proper Attitude to the Working Face" is as necessary as having the proper tools and equipment. Wilson described how employes at Bunker Hill are indoctrinated in safety from the day they are hired, and how he, as a foreman, follows through underground. An important part of the foreman's responsibility is helping his men develop a regard for personal safety and the safety of those about him.

"Administering a Safety Program at Southwest" was the subject of a paper given by Robert A. White, safety supervisor, Southwest Potash Co. According to White, mining potash is relatively safe as compared to hard rock or coal mining which, to a degree, breeds a lack of vigilance on the part of employes. He described various practices arrived at after persistent effort to establish a good safety program applicable to operating conditions in the district.

Lost production is a consequence of every accident, R. L. Wahl, Jr., assistant mine superintendent, Colorado Fuel & Iron Corp., told his audience as he discussed "Production and Safety." He explored case histories in pointing up the fact that, in addition to the victim's lost time, as much as 50 to 100 man hours may be chargeable to a single accident. Regardless of the amount of time lost, all accidents are costly to production, and they *can* be prevented by taking proper precautions in the beginning.

H. D. Stott, director of industrial and public relations, Calumet Division, Calumet & Hecla, Inc., spoke on "Responsibility of the Management Staff in Safety." Safety should not be looked upon as welfare work—it is part of the over-all responsibility for profitably running a company, he said. Stott discussed various aspects of staff responsibilities in promoting safety and said that success or failure of a safety program depends more upon "attitude" than on techniques or application of them.

"The Top Executive's Role" was set forth by C. D. Michaelson, general manager, Western Mining Divisions, Kennecott Copper Corp. He observed that a good safety program requires three things: (1) Top management belief in the importance of safety and willingness to give it high priority, (2) willingness to spend whatever amount it takes to achieve maximum safety, and (3) establishing direct line responsibility from the top executives down through work center supervisors. Although the fundamental purpose of a safety program is to prevent the suffering and heartache and tragedy that accidents bring, another important purpose is over-all cost reduction.

MANAGEMENT PROBLEMS

IN place of the scheduled chairman, E. I. Renouard, vice president of western operations for The Anaconda Co., Peter B. Nalle, superintendent of mining, Riverside Cement Co., presided at the Wednesday afternoon session devoted to problems of management policy.

Morley H. Matthewson, director of industrial engineering, International Minerals & Chemical Corp., spoke on the "Application of Industrial Engineering Principles in Mining." He pointed out that a good industrial engineering staff can be a real aid to hard-pressed executives. It can help them make decisions relating to many complex business problems such as choosing the best of several alternate methods of allocating resources, handling of human relations, or directing the attainment of sales and production goals. Matthewson presented a clear, concise picture of the contributions industrial engineering can make to mining, discussing such subjects as the I. E. Department's position in the organization, the type of backing and support which should be given it, the working relationships

C. D. Michaelson presented his views at the special "Viewpoints on Safety" session

Subjects of broad administrative interest were discussed by top-flight specialists at the Management Problems session

between line and staff, and the many types of service which the department should be expected to perform. He concluded by stating that there isn't any question that the mining industry can greatly benefit from the application of more industrial engineering principles.

"Cost Accounting as a Management Aid in Iron Ore Mining" was covered by Gordon T. Bethune, assistant comptroller, Oliver Iron Mining Division, U. S. Steel Corp. He asserted that cost control and cost reduction are the answer to the major problems facing the iron ore industry —competition and complexity of operations. He went on to describe a standard cost system used by his company and called it a logical and scientific approach to positive, effective control. Although not a cure-all, it does provide the facts which enable management to effectively measure and compare performance, plan expenditures, fix responsibility and pinpoint trouble areas for corrective action.

F. G. Kuehl, vice president-operations, International Talc Co., spoke on "Economics of Equipment Replacement in the Mining Industry." He proposed a method of calculating "pay-out time" for machinery replacement, and discussed the various factors that should be taken into account in making such a calculation. Kuehl stressed particularly that taxes are a prime factor, and cited two examples using the proposed approach.

In his presentation, "Foreman and Supervisory Training," James P. Logan, executive vice president, Mountain States Employers Council, Inc., stated that supervisory training as it is known today was forced upon industry as the result of World War II production demands. He showed that the training of supervisors is invariably necessary because no man comes equipped with all the abilities needed for a supervisory job. Logan discussed competition—local and international—and said that it is going to force industry to do a better production job both as to cost and to products. The supervisor, he pointed out, is the key man in accomplishing this.

A special session was devoted to the most important aspects of the uranium industry

Walfrid Been, professor and head, Department of Mining Engineering, Michigan College of Mining & Technology, spoke on the "Education of the Mining Engineer." He said that the problems facing the next generation of mining engineers will require more intensive specialization than that which characterizes the classical concept of a mining engineer today. He predicted the nature of the problems and prescribed the type of education that will be required to train mining engineers who are capable of solving them. Science background, he said, must be intensified at the cost of relinquishing time in other areas of training, but he pointed out the danger of subordinating the engineering qualities in a preoccupation with the scientific studies. Above all he stressed the need to train students in creative design, to give them confidence in their problem-solving abilities which can be projected into whatever situation the circumstances require.

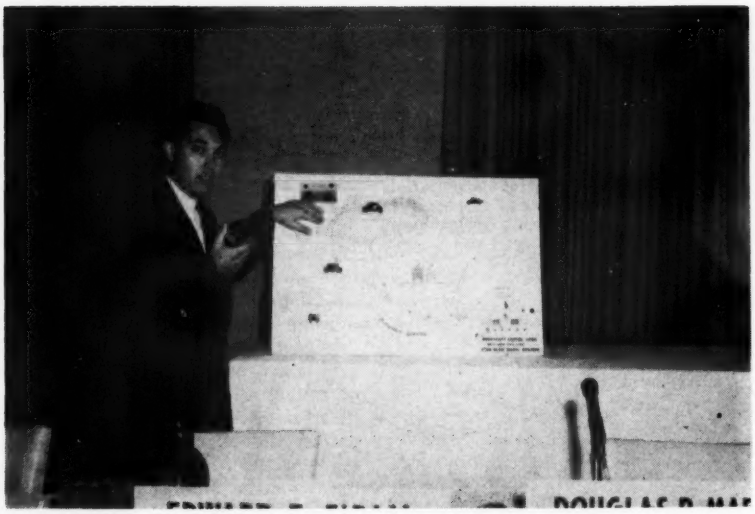
URANIUM

DEAN A. McGee, president, Kerr-McGee Oil Industries, Inc., presided over the Wednesday afternoon session on Uranium. He was assisted by Albert V. Quine, general manager, Lucky Mc Uranium Corp., who was vice chairman.

"Radiation Hazards in Uranium Mines and Mills" was the subject of a paper presented by Jesse C. Johnson, director, Division of Raw Materials, U. S. Atomic Energy Commission. He carefully traced the history of significant attempts to determine realistic radiation permissibility limits and described the work now being done along this line. Johnson commended the uranium industry for its outstanding metallurgical efficiency and mining technology and said that he had "no doubt that the industry will successfully solve its radiation problems and will meet the high standards that have been established for the protection of its employes."

Norman A. Spector, president, Vitro International, a Division of Vitro Corp. of America, presented an address on "The Outlook for Commercial Use of Uranium." He pointed out that in the past year factors influencing the growth of nuclear power on a world-wide basis have moved in a direction which will delay rather than hasten large commercial markets for uranium.

The U. S. uranium industry's ability to supply atoms for power is very strong, despite the present temporary



Douglas Mabey used a special chart with electric light indicators to describe the radio system at Kennecott's Bingham Canyon Pit

oversupply. This country has reserves which compare favorably in size with those of any other major producing nation. It has an industry which produces more concentrate than any other nation, and its reserves are of superior quality.

Spector concluded that the problem of anticipating new commercial markets is not unique simply because it is nuclear. With the assistance of a wise and cooperative government, he said, it seems certain that the uranium industry will enter commercial markets with the same leadership that has marked its entire history.

"Peaceful Uses of Nuclear Explosions" were described by Samuel G. Lasky, Staff Assistant for Minerals, Office of the Secretary of the Interior. He pointed out that the AEC weapons-testing program has yielded four facts of possible economic import: (1) great quantities of rock can be excavated by nuclear explosions detonated at shallow depths below the surface; (2) great quantities can be broken in place by deeply buried shots; (3) a large part of the energy released may be retained in the rock as heat; and (4) much or most of the fission products released may be sealed in rock melted by the blast.

Lasky noted that a dozen or more projects for testing and applying this information have been publicly discussed. Those farthest advanced are for excavating an artificial harbor in northern Alaska, for an explosion in salt beds near Carlsbad, N. M., to see if heat trapped in the molten salt could be used to generate power, and for cracking up oil shale preliminary to an attempt at retorting the shale in place. Mining proposals, he said, include removal of overburden and wholesale shattering of deeply-buried deposits.

Charles E. Violet, Lawrence Radiation Laboratory, University of California, discussed "Safety Procedures for Plowshare Projects." He explained that the Plowshare program is directed toward exploring the feasibility of various nonmilitary uses of nuclear explosives, and discussed the hazards associated with radiological effects, ground shock and air shock as they are manifested in various Plowshare applications. Violet described the safety procedures with respect to specific Plowshare projects, and pointed out that studies of the safety problems are proceeding concurrently with the technical portion of the Plowshare program.

Ralph E. Musgrove, chief metallurgist, Climax Uranium Co., speaking on "Measuring and Controlling Radiation in Uranium Mills," outlined the methods he used in determining the radiation intensity within the Climax Uranium Co. mill. He said that the dose of external radiation to which an individual has been exposed can be most conveniently determined by the use of film badges—sealed packages of photographic film and filters which integrate radiation exposure by proportional darkening of the film. After the film is developed the density of the image is measured and compared with the density of the image produced by exposure of the same lot of film to known quantities of radiation. From the relationship between the standard and unknown exposure the dose received by the individual is calculated. Methods of reducing the hazard of external radiation to personnel are: reduction of exposure time, increasing the distance between source of radiation and the subject, and shielding of the source.

In discussing internal radiation measurements, Musgrove emphasized that in measuring air-borne radioactive materials, the samples collected must be representative of the concentrations to which the workmen are exposed. He described the method and equipment used at Climax Uranium for collecting samples, and also discussed control of the concentration of radioactive particles by dust collection and personal respiratory protection.

GENERAL OPERATING PROBLEMS

CHAIRMAN of the Wednesday afternoon session on General Operating Problems was R. R. Williams, Jr., manager of mines, Colorado Fuel & Iron Corp. Vice Chairman Clyde D. Keith, supervisor of new developments, Pickands Mather & Co., also acted as moderator of a Panel on Two-way Radio Communications.

H. J. Benecki, staff metallurgist, Park Works, Crucible Steel Co. of America, presented a paper on "Special Steels for Special Mining Jobs." Pointing out that a knowledge of the factors affecting steel quality is valuable in selecting the right steel for the job, Benecki discussed the fundamental properties of steel and the effects of various alloying agents. He further showed how these properties could be applied to steels for special mining jobs and indicated specific uses for particular steels.

The remainder of the session was devoted to the Radio Panel. On the panel were Edward F. Eidam, assistant to general manager, Pacific Isle Mining Co.; Douglas R. Mabey, contract engineer, Utah Copper Division. Kennecott Copper Corp.; Edward J. Matousek, manager of general engineering, International Minerals & Chemical Corp.; and R. V. Bovenizer, chief electrical engineer, Hanna Coal Co.

An explanation of what two-way radio is, how we have come to use it, its basic components and how it works was presented. Specific examples of applications of two-way radio in mining operations in various districts were given. The panel also discussed the future of two-way radio in the mining industry and explained what it means to its users in terms of dollars and cents.

Advances in Roof Control

Fig. 1. Roof bolting equipment is mounted on either side of the ripper-type machine. The two hydraulic jacks are connected by a beam formed of two steel rails which is raised against the top to protect the workmen while they are bolting

By JAMES T. JONES
Assistant Superintendent
Mather Collieries

A round up of the most recent developments in controlling mine roof on continuous mining sections.

ROOF control for continuous mining equipment is one of the most, if not the most important factor influencing the rate of productivity with continuous mining machines in many coal mines. A great amount of progress has been made in this field through the close cooperation of the coal companies, State departments of mines, U. S. Bureau of Mines and mining equipment manufacturers. The writer would like to express his appreciation to these organizations and manufacturers for their assistance and the many courtesies extended to him by them in the preparation of this article.

When continuous mining was first started in areas requiring roof support, side posting or timbering was an accepted procedure. Progress has been made in these methods of roof support since that time to provide a safer and more continuous operation. In many mines these timbering methods are still being used with very good results. At the present time there are some companies doing experimental work on other timbering devices but this has not yet progressed far enough to evaluate them.

Roof Bolting Equipment Mounted on Machine

A definite forward step has been taken by mounting the roof bolting equipment on either side of the ripper-type machine. These bolting units derive their power from the hydraulic system of the continuous mining machine, which necessitates larger hydraulic capacity in the machine's construction. Figure 1 is a picture of a ripper-type machine with a roof bolting unit mounted on either side of the machine. Directly ahead of the roof bolters are two hydraulic jacks connected across the top by a beam formed by two steel rails. This hydraulic beam is raised against the top to protect the workmen while they are bolting. The bolting operation is performed during the time that the machine is mining coal but at a time when the undercarriage of the machine is at rest and must be completed before it is time to move the continuous mining machine forward for the next sump. Little delay to the continuous operation of the ripper-type machine is caused during the installation of roof bolts by this method.

This system of mining and bolting has produced many different patterns and most of them are similar. One of these is shown in figure 2 which is a bolting pattern being used over ripper-type machines in a mine operating in the Pittsburgh seam of coal in the Tri-State area of western

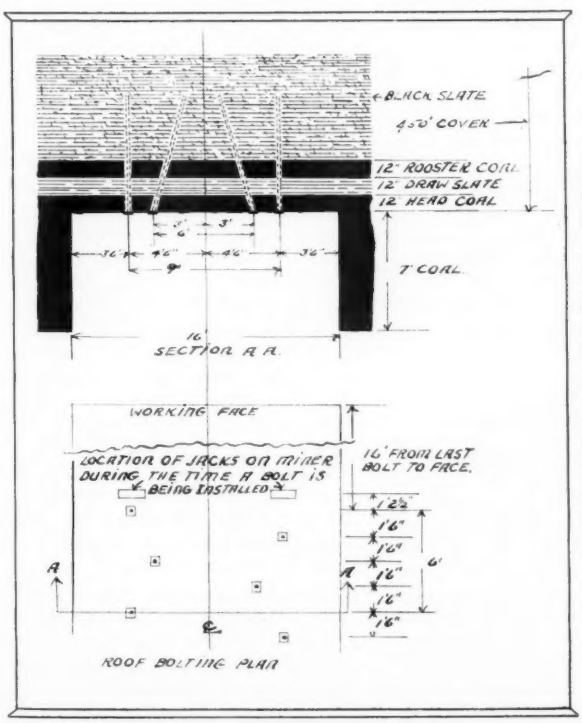


Fig. 2. A bolting pattern being used over ripper-type machines in a mine in the Tri-State area of western Pennsylvania, northern West Virginia and eastern Ohio. The lower part of the figure is a plan view showing the spacing of the bolts in an entry, room or crosscut. The upper part is a section looking toward the face and shows the angle at which the holes are drilled and a typical roof section over the Pittsburgh seam in this area

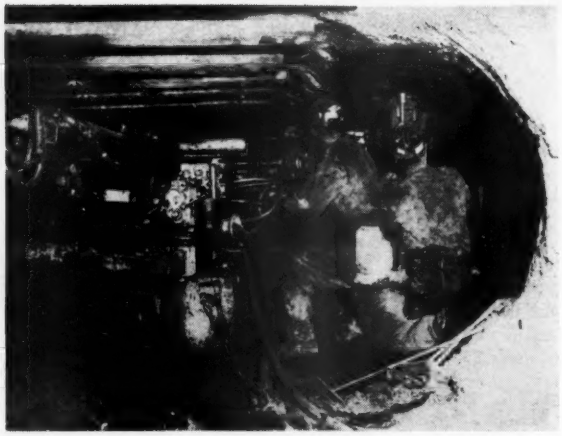


Fig. 3 and 4. Bolting for roof control over a boring-type machine is more complicated than over the ripper-type because the boring-type moves continuously while cutting. This problem has been overcome in a mine operating in the West Virginia Panhandle by the development of "satellite" bolters. In the picture on the left, the bolter is located at "A". Directly ahead of the bolter, at "B", is a pulley arrangement with opposing pulleys mounted on either end of a hydraulic jack. The pull rope is fastened to the bolter near its base. To move the bolter, power is applied to extend the hydraulic jack which shortens the pull rope and moves the bolter head. The picture on the right shows a bolter operator operating the drill while the machine is making a side cut

Pennsylvania, northern West Virginia and eastern Ohio. In this figure the lower part is a plan view showing the spacing of the bolts in an entry, room or crosscut. The upper part of the figure is a section looking toward the face and shows the angle at which the holes are drilled and a typical roof section over the seam in this area. Some variations to this are followed at other mines depending on the type of mining being done. For example, an open end requires some posts and/or cribs along the open end to supplement the bolting pattern. In a wide room the side holes may be angled toward the ribs.

Machinery on a typical section in the Tri-State area consists of the continuous mining machine with its roof bolters mounted on either side, a pickup loading machine, two shuttle cars and a belt on the panel entry. A typical face crew consists of:

1 continuous mining machine operator
2 roof bolters
1 loading machine operator
2 shuttle car men
1 foreman
½ mechanic

for a total of 7½ men. It may be of interest to note that besides their bolting operations the bolting machine operators supply themselves with material from the ramp and take care of the line brattice work. The average tonnage for these units amounts to approximately 400 tons of clean coal per shift for 90 ft of advance in a 16-ft working place. Production per man-shift on these crews is averaging approximately 50 tons.

Where practical it is a common practice in the Pittsburgh seam to leave a foot of head coal below the draw slate to help support it. This procedure is being followed in most instances where the roof is supported by bolting over ripper-type machines. An exception to this is an operation in the West Virginia Panhandle area where the seam is less than six ft in height. Here the continuous mining machine is cutting the coal up to the draw slate. To secure this top, 2 in. by 8 in. by 12-ft planks are placed against the draw slate on centers varying from 42 to 48 in. and held in place by two bolts, each of which is located 4 ft 2 in. on either side of the center line, making them 8 ft 4 in. apart. The bolts are installed vertically, not angled, and are either six or seven ft long depending on the length needed for good anchorage. By using planks in this manner, with both ends anchored by roof bolts, any vertical movement of the top over the plank between the bolts places the plank in tension rather than shear which greatly increases its load-carrying capacity. This type of roof control has enabled continuous mining machines at this mine to achieve better tonnages than were attained by other methods. The operation is averaging approximately 400 tons of clean coal per shift while advancing 120 ft and has a record of producing 750 tons of clean coal per shift while advancing 230 ft.

Satellite Bolters Developed

Bolting for roof control over a boring-type machine is more complicated than over the ripper-type due to the fact that the boring-type machine is continuously moving while cutting. This problem has been overcome in a mine operating in the West Virginia Panhandle by the development of satellite bolters. These drills are drawn along the side of and receive their hydraulic power from the continuous mining machine. Figures 3 and 4 are pictures of this machine showing the satellite bolters on either side of the machine. Figure 3 is a picture of the left side of the boring-type machine looking back towards the tail section. In this picture the bolter is located at "A" and consists of a mast mounted on a shoe. As shown, the mast has been extended hydraulically so that it is wedged against the roof, making it rigid. The mast also serves as a safety post. A rotary drilling head is mounted on the mast and is moved up and down by a chain feed actuated by a hydraulic motor. Directly ahead of the bolter at "B" is a pulley arrangement with opposing pulleys mounted on either end of a hydraulic jack. The pull rope is fastened to the bolter near its base. To move the bolter, power is applied to extend the hydraulic jack which shortens the pull rope and pulls the bolter ahead. When the bolter reaches the position of the next hole to be drilled, the jack is collapsed leaving the draw rope loose so that the continuous mining machine can continue to cut and move ahead while the bolter remains in that position to drill the next hole.

An improvement on this machine since the picture was taken has been the angling of the jack and the addition of an arm on its upper portion. The arm extends downward to a point directly ahead of the base of the bolter where it is attached by a horizontal pin to the bolter. When the jack is extended, this arm raises the bolter slightly and assists the draw rope in drawing the bolter forward.

Figure 4 shows the bolter operator on the right side of the machine operating the drill while the machine is making a side cut. This bolter operates in exactly the same manner as the one on the opposite side. Figure

5 is a drawing showing the bolting pattern being used with this machine, and it will be noticed that the machine is cutting a place 14½ ft wide. No particular effort is made to leave any head coal in place and as a rule the coal is cut up against the draw slate. The roof is then supported by placing a plank, 2 by 8 in. in cross section, against the draw slate and bolting it in place with two bolts which are either six or seven ft long. The maximum allowable distance between planks is five ft and the bolts across the heading cannot be more than 10 ft 6 in. apart. The bolter on the right side operates about five ft ahead of the bolter on the left side of the continuous mining machine and a typical cycle in installing a plank would be as follows:

1. The bolter operator on the right side places his bolter in position for drilling.

2. He slides a plank into position across the machine, placing his end on top of the mast and raising it up against the roof by hydraulic action.

3. Next, he drills his hole through the plank into the roof strata and installs the bolt, using a 4 by 4 in. bearing plate against the plank.

4. He then moves his bolter ahead 5 ft to the location of the next plank and the bolter on the left side advances 5 ft and, by installing the bolt on his side, completes the bolting of that plank.

Besides their bolting operations the bolter operators also take care of the brattice work.

Continuous mining machines working under this method are averaging approximately 400 tons of clean coal per shift and are advancing at an average rate of 133 ft per shift while operating in a five-ft seam of coal. The maximum clean coal tonnage produced at this operation in a single unit shift to date has been 600 tons while advancing 203 ft. The face crew on this section is made up as follows:

1 operator
2 roof bolters
1 loading machine operator
2 shuttle car men
1 foreman
½ mechanic

for a total of 7½ men. This crew is averaging approximately 50 tons per man.

Problems in Thin Seams Examined

In central Pennsylvania there are many boring-type machines operating in the thinner seams of coal. Considerable mining is being done in the Upper Freeport seam under ideal roof conditions. It is common practice in this seam, with continuous mining machines, to drive rooms 18 ft wide, leaving a 20-ft pillar of coal to be extracted after the room has been extended its distance. Experience has shown that the top in this seam rips along the side and, as a consequence, it is customary to post along the ribs to help prevent this ripping and also to give additional warning before an impending fall. In a majority of these mines shuttle cars are being used for face transportation and, to facilitate their movements, it has become a standard practice to maintain a 14-ft roadway between posts.

In this same area there is a mine operating in the Lower Kittanning seam where roof bolts are used for roof control over the boring-type machine. The seam being mined is 38 in. thick and is overlaid with six in. of bone coal and ten in. of draw rock which need support. Directly over this is a strong shale rock. By using 30-in. bolts the bone coal and draw rock are pinned with the shale forming a strong top. Where conditions warrant, a 36-in. bolt is used in place of the 30-in. bolt. For installing bolts a low, portable, hand-drawn drill mounted on three wheels is used.

At this operation rooms are being driven 30 ft wide, 325 ft deep and on 50-ft centers. The 20-ft rib is mined out between the room and the adjacent gob after driving the room to its limit. In mining this coal the boring-type continuous mining machine dumps the coal onto the ground directly behind it. The coal is picked up by a pick-up loading machine from which it passes successively to a piggy-back, a chain room conveyor, a chain gathering conveyor and a chain elevator into the mine car.

Figure 6 is a drawing of the min-

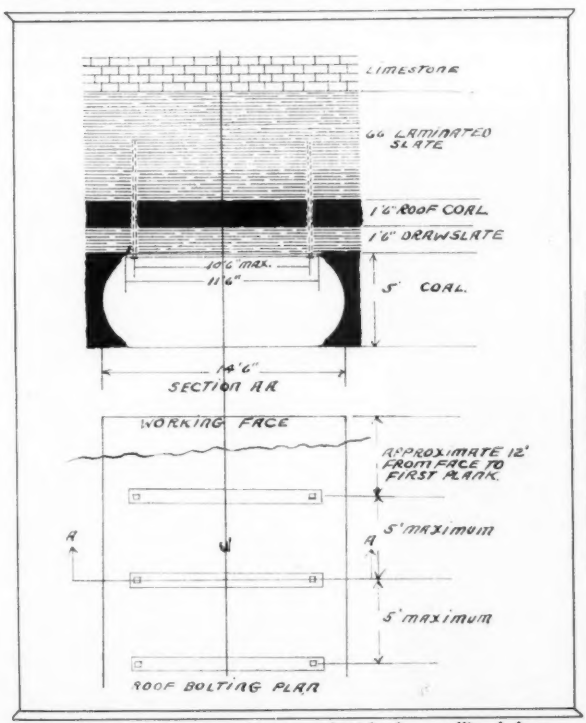
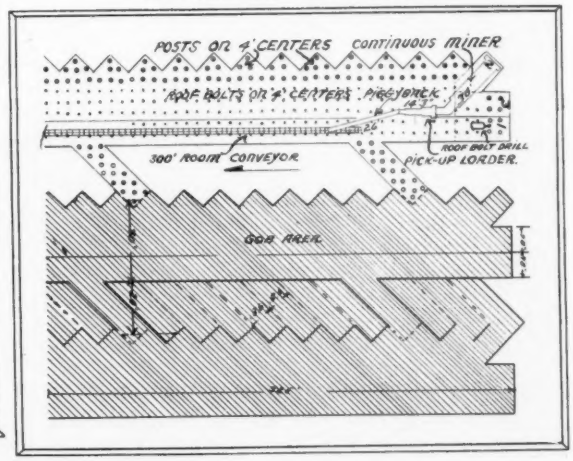


Fig. 5. Bolting pattern being used with the satellite bolters

Fig. 6. (Below) Roof bolts are used for roof control over the boring-type machine at a mine operating in the Lower Kittanning seam. Bolting and posting are done in cycle with the operation of the continuous mining machine as it advances the room by taking three cuts across the face. No. 1 cut is removed first. While No. 2 cut is being removed, four posts are placed in a row down the center of No. 1 cut and then two rows of bolts installed in that cut to within four ft of the face. While No. 3 is being removed, side posts are installed to the face in No. 2 cut. Upon the completion of No. 3 cut, a row of jacks is set down through the middle of that cut and it is bolted with two more rows of bolts. During the bolting of No. 3 cut, the pan line is extended



ing system used in this mine showing the standard system of roof support in room and pillar workings. The roof in the room is supported by bolts on four-ft centers, except for that part along the saw-toothed edge of the room which is supported by posts on four-ft centers. Bolting and posting are done in cycle with the operation of the boring-type machine as it advances the room by taking three sumps across the face. Each of these sumps is 9 ft 8 in. wide and 20 ft deep. To clarify the cycle of operations these three cuts at the face are numbered showing the sequence in which they are removed. No. 1 cut, of course, is removed first. While No. 2 cut is being removed, four posts are placed in a row down the center of No. 1 cut, following which, the two rows of bolts are installed in that cut to within 4 ft of the face. While No. 3 is being removed, side posts are installed to the face in No. 2 cut. Upon the completion of No. 3 cut, a row of jacks is set down through the middle of that cut and it is bolted with two more rows of bolts. During the bolting of No. 3 cut the pan line is extended; then the sequence is repeated.

This continuous mining machine is producing approximately 265 tons of clean coal and advancing at the rate of 75 ft in a 30-ft room each shift. The crew consists of the following:

1 boom man
1 continuous mining machine operator
1 loading machine operator
2 roof bolters
1 utility man
1 foreman

for a total of 7 men. The machine has operated for four years with this system with a very good safety record and is at present producing approximately 38 tons of clean coal per man-shift.

Arch Left by Mining Machine Used for Support

Information was obtained concerning the operation of a boring-type machine being operated in the Pittsburgh seam of coal in northern West Virginia. This machine makes a cut 12 ft 10 in. wide and 7½ ft high. The operation is particularly interesting because the arched top cut by the machine is being depended upon to support the top and has been doing an excellent job. From 10 to 12 in. of head coal is being left in place. This is overlaid successively by 6 to 12 in. of draw slate, 10 to 12 in. of rooster coal and then black slate. Development entries, crosscuts and rooms are driven on 90-ft centers and are bolted only at the intersections by two single rows of bolts intersecting at 90° and forming a cross in the center of the intersections. Unusual conditions, however, require additional support. Five and one-half and 6½-ft bolts are being used and bolting is being done with stopers after the working place has been advanced its distance and the machinery is moved to the next place. On rib extraction, gob splits are driven 12 ft 10 in. wide, leaving a 12-ft fender to be removed in pillaring. None of the rib work is bolted under normal conditions; breaker posts are set for protection while removing the fender.

Continuous mining machines of this type at this operation have mined 1,500,000 tons of coal under this system so far without a serious accident from roof falls. They are producing approximately 450 tons of clean coal per shift and a face crew consists of the following men:

1 continuous mining machine operator
1 continuous mining machine helper
1 shooter-roof bolter
1 brattice-pipeman
2 shuttle car operators
1 tippleman
1 foreman

for a total of eight men. This crew is averaging approximately 55 tons per man-shift.

In all mines visited in gathering data for this article, ⅝-in. 1040 grade steel bolts were being used with various types of expansion shells. The bolts were being installed with an initial torque ranging from 120 to 140-ft lb. For bearing against the roof embossed steel plates, drilled cap-pieces or planks were being used.

The foregoing are methods which are being used successfully for roof control over continuous mining equipment. They have established their value through greater safety and productivity but the importance of roof control is a constant challenge to the industry to develop new and improved methods.

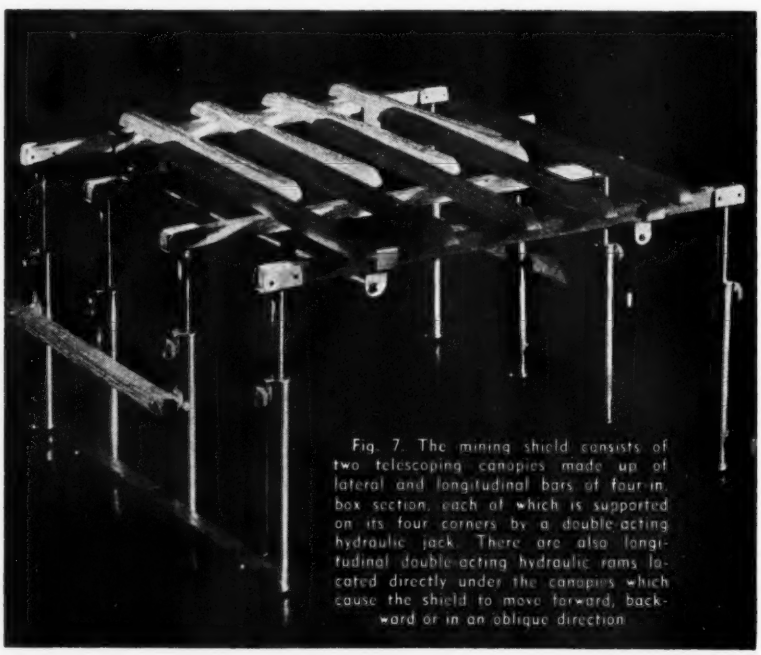


Fig. 7. The mining shield consists of two telescoping canopies made up of lateral and longitudinal bars of four-in. box section, each of which is supported on its four corners by a double-acting hydraulic jack. There are also longitudinal double-acting hydraulic rams located directly under the canopies which cause the shield to move forward, backward or in an oblique direction

Mining Shield Offers Possibilities

Recently a mining shield has been developed by the U. S. Bureau of Mines which has been designed for roof protection of men and mining equipment in the face region. In a letter written pertaining to this invention, the following claims were made: "This apparatus is designed for supporting the roof of excavations made underground such as the roof of coal or mineral mines and/or tunnels driven into strata and designed for the purpose of giving protection against material which falls from the sides of openings, thereby protecting workmen and equipment from sudden cave-in or falling rock and material." An English firm has recently entered into an agreement to manufacture this shield and it should be on the market within a short time.

Figure 7 is a picture of the model of this shield showing it in a partially extended position. The shield consists of two telescoping canopies made

up of lateral and longitudinal bars of four-in. box section, each of which is supported on its four corners by four double-acting hydraulic jacks. Hydraulic power is obtained from a connection to the hydraulic system of the machinery operating under its protection which is the only connection between the shield and this equipment. There are also longitudinal double-acting hydraulic rams located directly under the canopies which cause the shield to move forward, backward or in an oblique direction.

To better illustrate the manner of moving the shield, the following steps that would be taken in advancing the shield are listed as follows:

1. The four jacks supporting the back canopy would be extended, forcing the canopy against the roof with a pressure of 1½ tons on each jack. The pressure is limited to this amount to prevent bending the canopy against uneven top but each jack is designed to support a load of nine tons as the load is applied from above.

2. Jacks on the forward canopy would be collapsed enough to let the weight of it rest on the center lateral bar of the rear canopy so that it could be slid ahead on that bar by the hydraulic rams.

3. The jacks on the forward canopy would be extended, forcing it against the roof, and then by collapsing the legs of the rear canopy, it could be brought ahead in a similar manner.

4. The shield could be moved in an oblique direction by applying unequal pressures to the hydraulic rams. With a four-ft spacing between longitudinal bars, the shield can be moved at an angle of 24°.

As designed, all parts are to be assembled by pins so that any component of the shield can be removed by withdrawing certain pins. The shields can be made in different lengths and different widths; the width being determined by the length of the lateral bar. The bar is telescopic, adjustable as to width and made rigid by the insertion of pins. This feature permits the shield to be collapsed so that it can be placed on the top of the continuous mining machine or any other piece of mobile equipment and moved to another location intact.

Although this shield has not yet been tried, those who have seen the model are enthusiastic about its possibilities. It would provide a continuous support over the operator of the continuous mining machine while operating in the face area and also provide the necessary temporary support to those installing some form of permanent support. The jacks are designed to carry a total load of 72 tons and the open design of the canopy provides for the easy installation of bolts.

Bureau Continues Experimental Work in Roof Cementation

The Bureau of Mines is continuing its experimental work in roof cementation by injecting resins into the rock strata over the coal seam at pressures varying from 600 to 1150 psi. In this experimental work both epoxy and polyester-type resins have been used as the bonding agent and it has been necessary to mix these resins in certain proportions with a second compound called a hardener or catalyst to produce solidification. At an ambient temperature of 58°F the cure time of both epoxy and polyester resins when mixed in the proper proportions with a catalyst, in mine roof, have been found to be approximately 25 and 105 minutes respectively. The experiments have been successful enough that plans are now underway and new equipment is being designed to try this method of support on an operating section using conventional mining equipment. Further study and experimentation will be needed before roof cementation can be recommended as a form of roof support for continuous mining.

One of the roof bolt manufacturers has developed a process in which epoxy resin is being used to strengthen and improve the anchorage characteristics of shells installed in soft materials. A capsule of the resin, containing 15 grams, is inserted in the hole on top of the shell. The capsule is broken against the top by the pressure of the bolt as it is installed and the resin is retained around the shell by a seal at its base. The seal is composed of a sponge rubber washer sandwiched between two metal washers and special ears are required on the bolt to accommodate the washers. The shell is cemented in place forming a cohesive mass with the rock, eliminating bleed-off in torque and disintegration of the rock around the installed shell in the borehole.

Other experiments are no doubt being made by other companies for the control of roof but for the preparation of this article the writer was unable to obtain sufficient data concerning them.

Apparently there is no limit to the mining man's ingenuity as he strives to overcome the obstacles confronted in controlling roof. Great progress has already been made to obtain a safer and more productive operation through improved methods of roof control and undoubtedly greater strides are yet to be made.

MINING on the PLATEAU

By J. R. BORDEN
Mine Superintendent
Union Carbide Nuclear Co.

Uranium ores in relatively inaccessible areas can be extracted profitably — by utilizing contracts, small working crews and varied techniques — as demonstrated at the numerous operations of Union Carbide Nuclear Co.

MINING on the Colorado Plateau is not a recent venture for Union Carbide Corp. It was in 1926 that the company entered the Colorado scene by purchasing United States Vanadium Corp. which consisted solely of a small vanadium plant at Rifle. Two years later the Uravan and Paradox Valley properties of Standard Chemical Co. were acquired. Similar expansions have been taking place ever since. This discussion will be concerned only with Union Carbide's operations in the uranium mines in the Uravan Mineral Belt. These mines are located about the Colorado Plateau in Utah, Temple Mountain and Polar Mesa areas, and in Montrose, San Miguel, and Mesa Counties in Colorado. Mills are located at Green River, Utah; Rifle, Uravan, and Slick Rock, Colo.

Ore Averages 0.20 to 0.30 Percent U_3O_8

This article is concerned essentially with those ore deposits in the Salt Wash member of the Morrison formation. The Salt Wash formation consists of alternating layers of sandstones, which were deposited in a stream environment, and mudstones, which accumulated in a floodplain environment. The major concentrations of ore lie within the sandstones and occur as flat lying pod or lens shaped masses, or flat tabular masses that tend to abruptly pinch and swell. Ore minerals occur as interstitial fillings between sand grains, as replacement of woody or plant material, and associated with mudstone within the sandstone. Thickness varies from a few inches to as much as 40 ft, with an average of two to four ft.

Individual ore deposits range in size from a few feet wide, containing a few tons of ore, to a few hundred feet containing thousands of tons. A typical mine is composed of several of these deposits which may not be connected by mineralized layers of rock. The deposits have a spotty distribution but tend to cluster in relatively small, poorly defined patches. Occasionally they are elongated parallel to the direction of stream deposition, while in other cases, no geometric shape or orientation is evident. The average grade of ore from a typical Salt Wash mine will be from 0.20 to 0.30 percent U_3O_8 and 1.00 to 2.00 percent V_2O_5, but there are local variations in these ranges. Producing grade is greatly influenced by the dilution with waste and low grade ore during mining operations.

Old Operations Reopened

Uranium mines in the Colorado Plateau are invariably located in remote areas, making it necessary to truck the ore to the various mills. The roads vary from oiled highways to poor dirt roads, which are almost impassable during certain times of the year. Haulage is contracted and costs range from $0.60 to several dollars per ton, depending upon road conditions and distances.

Union Carbide mines differ greatly in size and type—from a two-man operation with a mule and a cart, to the large, fully mechanized mines employing as many as 170 men. Approximately 60 percent of the mines employ less than six men. Many

The mines range from a two-man operation with a mule and cart to fully mechanized mines employing as many as 170 men

mines that were considered depleted and were closed several years ago are now being worked profitably by one or two men. In one area, where Standard Chemical Co. operated 38 mines in the 1920's, 34 have been rehabilitated and are now operating profitably.

Approximately 50 percent of Union Carbide's production comes from reopened mines; new mines which justify a crew of only three to six men, or mines which have been large producers at one time, but now will justify only a two or three man clean-up operation. Of this 50 percent approximately 15 percent is coming from mines reopened after being closed because of apparent depletion of reserves or inability to meet grade requirements.

Mines are opened by horizontal adit, incline adit, or vertical shaft, as determined by physical and economic conditions. Smaller mines, producing only 50 to 100 tons per month, employ two to three men. Streaks of ore down to six or eight in. thick, are worked, hand mucking into a wheelbarrow or a small mine car. When a thin streak of ore is mined, the miner usually excavates only enough ground to allow room to work—sometimes long handled hoes are used in excavations too small for a man to enter.

In contrast to the operation just described, Union Carbide has mines which produce up to 6000 tons per month using modern, mechanized equipment. These operations are closely supervised with emphasis on engineering and geology—all development work is done to specification. The stoping and mining operations are by no means the "gopher-hole" type previously described. Tons per man shift at larger units is approximately six, compared to the smallest of one ton or less.

Three Types of Contracts

Nearly all mines are contract operated. Often, a contractor, his brothers, and sons may operate a mine and such a group can and does produce more ore, cheaper, than a large company could possibly do. Most of these small contractors have had years of experience, and are experts at this type of mining, where ore bodies average two to four ft in thickness. Sometimes a contractor will reach a point where he can no longer operate at a profit, but another, with a different crew, can make the mine pay off well. Contracting has relieved the company of the expensive burden of warehousing a large store of supplies, tools, and small equipment.

Three types of contracts are in effect at the present time. The first type provides for payment to the contractor for all development, for all supplies of a permanent nature, and for the pounds of U_3O_8 contained in the ore, delivered to the ore bin at the mine. The second type provides for payment on the same basis as above, except there is no payment for development work. The contractor furnishes all supplies and delivers the ore to the mill. Most mines covered by this type of contract are wheelbarrow, horse and cart, or clean-up operations, producing 50 to 100 tons per month. The third is a bonus type contract where the contractor is paid a fixed fee per month, from which he pays his own costs. The total mining cost, less an allowance for development, is figured on a per pound basis at the end of each month, and if the per pound cost is less than a certain amount, the contractor and his employees participate in a bonus. At present four of this type of contract are in operation.

One of Union Carbide's larger operating units consists of three shafts interconnected by two levels. Material from the upper level is dumped through a pass to a slusher slot on the lower level, where it is slushed into a measuring pocket and dumped into the skip, while material from the lower level is dumped directly into the slot.

All development drifting is done 20 to 60 ft beneath the ore horizon. From the main drift, raises are driven to ore which is then mined by the room and pillar method using electric slushers to muck into chutes. On main levels, 1½ and 3-ton battery locomotives with 32 cu ft rocker-dump cars are used to haul muck to the measuring pockets. The drifting, all being done beneath the ore, enables the extraction of nearly 100 percent of the ore. It also enables the company to carry on a more effective long-hole drilling program. One disadvantage of this program is that the greater portion of haulageways occur in a shale or mudstone which require ground support such as timbering or roof bolting.

Another large operation under development will be similar to the operation above, with the exception that haulageways are nearer, and sometimes within, the ore horizon. The mine and surface plant were designed and planned for an ultimate production of 4000 to 5000 tons per month. A three-compartment shaft, with two hoisting compartments, was sunk to a depth of approximately 750 ft. Either ore or waste is handled in a vertical type, concrete, divided pocket. Much of the development was completed before any mining was begun. At the extreme end of the orebody a 32 in. cased churn drill hole was drilled as an escapeway and ventilation shaft.

At both of these properties, extensive underground exploration drilling is carried along with development drifting. Although preliminary drilling of deep orebodies is done at the surface, it is completed underground, where possible, because it is far less expensive.

In the Uravan area Union Carbide is opening a mine by means of a 760 ft incline adit that is being driven on a −25 degree slope. An overshot loader with a slope attachment is used to muck into a 4½ ton Granby car which is hoisted to the surface and dumped automatically at the waste area. When necessary, the area is cleared with a bulldozer. After min-

ing commences, loading the Granbys will be accomplished with shuttle cars and an overshot loader—ore will be dumped automatically into orebins at the surface by means of a camel back. It is estimated that eight to ten men working this property will produce 2000 to 3000 tons per month. A similar unit is being developed through a 2000 ft horizontal adit, but rail haulage will be used rather than shuttle cars which, incidentally, are able to negotiate grades of 12 to 14 percent.

For over a year the company has operated one property as an experimental mine. It is a trackless operation except for the incline upon which a Granby car is installed to dump automatically. In addition to an automatic hoist operated by push button, the mine is equipped with shuttle cars and an overshot loader.

At still another operation a three-compartment shaft was sunk to an orebody, part of which had been faulted 80 ft. The shaft was located near the fault and sunk to the deepest ore. Two levels were established, the lower having a slusher slot pocket with two passes to the upper level. Mining in the lower level is within the ore horizon, and since the ore is near drift level it is slushed to the drifts and loaded into cars with an overshot loader. But on the upper level, raises are driven from drifts beneath the ore horizon, and mined ore is mucked into chutes using 5 to 15 hp electric and air slushers. At the far end of the orebody a 32 in. cased hole was drilled to the upper level for ventilation and as an escapeway. The mine produces 2000 to 2500 tons per month with a crew of 15 men.

Since the first of this year the company has opened the deepest operation in the Uravan area. The last 622 ft of a 673 ft shaft were sunk by a local mine contractor in 93 days. A Ridell mucker, a 1½ ton sinking bucket, and a crosshead were used in the sinking operation. At this particular mine, it was not felt a pocket or other elaborate loading set-up was necessary. Therefore, one ton cars are used which dump directly into a skip. This mine is able to produce from 1000 to 2000 tons of ore per month along with some development work.

Panel And Slot System Used

Union Carbide has operated one unit for eight years and for the last three years it has produced approximately 2000 tons per month. A 40-ft thick orebody is mined by a panel system, whereby slots 15 ft wide are driven through the orebody, leaving 10 ft panels between the slots. After all slots are driven, the panels are divided, and the better ore is removed, leaving the lower grade in pillars. By selectively mining panels, recovery ranges from 90 to 95 percent of contained U_3O_8. The operation, from the standpoint of cost, safety, and extraction, has been highly satisfactory.

Long underground inclines have been driven to open orebodies discovered after exploratory drilling at several operations in the Uravan area. For example, a 1000 ft incline was driven at −10 percent grade at one mine. Five one-ton capacity cars can be handled per trip by a 25 hp hoist installed at the top of the incline. But ore may have to be hoisted up as many as three inclines before reaching the surface at other units. The inclines are usually short and seldom exceed 25 degrees in grade. They are usually the result of having originally opened the mine without planning for future drilling around the immediate orebody.

In Utah, the company has been operating a mine through a 36 in. by about 200 ft Calyx hole. A sinking bucket, which just fits the hole, carries approximately one ton of material to the surface per trip. The orebody, which dips at 5 to 6 degrees, is ideal for using diesel shuttle cars to transport ore and waste at a rate of approximately 1000 tons per month with a crew of five to seven men. This particular orebody is within the Chinle Formation, but mining conditions here are very much the same as in the Salt Wash.

Mining costs in Colorado are somewhat higher than at some uranium mines in New Mexico, Wyoming, and Utah. Although there are many reasons for this, the principal one is related to size and location of deposits. Orebodies were first discovered at the "rim" and later in shallow ground by exploratory drilling. These orebodies have gradually been mined out and mining is continuing at depths up to 1000 ft. Location and mining of deep, relatively small, and often discontinuous orebodies is necessarily a costly procedure. However, in order to offset high costs the company carefully plans the drilling, opening, equipment and mining functions, and is constantly seeking the most economical methods for operating.

ADVANTAGES of HIGHER UTILIZATION VOLTAGES UNDERGROUND

By JAMES A. ERSKINE
Electrical Engineer
Eastern Gas & Fuel Associates
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Higher voltages are needed to improve regulation, reduce inrush current and increase length of secondary feeders

OVER 16 years ago the author presented a paper entitled, "Past, Present and Future Use of Electricity in Coal Mining."

There were several reasons for presenting this paper. One was to give something in the way of a "historical resume" of the application of electricity to coal mining, another was to talk about the ever-increasing loads due to mechanization, and a third reason was to advocate the use of a-c power to reduce the increasing losses.

At that time it was pointed out that because production and best results depend on continuous operation of the equipment at rated speed, industry must provide a reliable and adequate source of power. Frequent power interruptions and low voltage conditions could not be tolerated. With the few hours worked on each shift, any interruption from circuit breaker operation due to lack of capacity, or any lost time from other delays, meant lost tonnage with no reduction in labor cost.

While conditions of this nature exist in many mines and much tonnage is lost, the problem of proper and adequate power distribution is probably the easiest to solve. For a given load, distance and voltage drop, it is very simple, through the use of accurate formulas, to determine the proper size of conductors or feeders.

However, in the past little use has been made of formulas in general around the mines and it has been the practice of those in charge to either use what they had, or roughly estimate the size of feeders from sizes that were familiar to them—power would be good, fair, poor or bad. In many cases bad.

Economics of Inadequate Feeder System Analyzed

In a large number of instances the waste due to this method of arriving at feeder sizes is not fully appreciated. The losses in the distribution system represent a proportional loss of power delivered to the substation, which serves no useful purpose. For instance, supposing a 500-kw rectifier, motor-generator set, or rotary is carrying its rated output of approximately 1800 amp at 275 volts and the average voltage at the face equipment is, say, 180 volts, which is not uncommon, the line drop is 95 volts and the power loss is 171 kw, or about 34 percent of the substation capacity. In other words, instead of having approximately 500 kw available for mining coal, there is actually 329 kw.

In analyzing the cost of these losses, let us assume that a 500-kw substation, including conversion equipment and building, etc., costs $65,000 and that 34 percent of its capacity is lost in d-c power transmission. This means that $22,000 has been invested in substation capacity to provide for transmission losses. In addition to this, there is the cost of kw-hour losses, cost of reduced cable life due to excessive heating, and cost of increased maintenance.

This waste of power and increased substation investment is, by no means all that is involved because, with low voltage, motor speeds are reduced with consequent loss in production. Putting it another way, the capacities of machines are impaired, requiring more units to produce the desired tonnage.

Line Losses Proportional to Square of Load

It should be borne in mind that even under the very best conditions a certain amount of energy is lost in transmission. There are always "line losses" no matter how perfect a system may be, and the problem is to keep them as low as possible, consistent with good economic practice. Few mining men understand that when the load on a system is increased, the line losses do not increase in the same ratio but vary as the square of the load. For example, by doubling the load, you increase the line losses four times, not twice.

Sometime before writing the paper in 1943, the author had witnessed some 230-volt power installations for the operation of 11-BU loading machines and, in checking the size of feeders and trailing cables, etc., he could see that industry had reached

the point where even with still larger feeders, the losses and voltage drop were beyond the range of 230 volts.

With this in mind, the following comments were made in his paper:.

> "In view of these tremendous losses and increasing loads, the time has long since arrived when we should be giving more serious consideration to the use of a-c power for concentrated mechanical mining. This, as some of you know, is nothing new, as it has been in use in coal mines for many years. In fact, about 30 years ago, in Scotland, I had much experience in the installation and operation of 440-volt equipment in coal mines, including mining machines, conveyors, pumps, and hoists, etc."

However, while conditions were not too good in the case of the 11-BU loading machines, the situation has been greatly aggravated recently with the advent of the higher horsepower continuous mining machines, and industry has reached the point whereby it is neither practical, economical, nor good engineering practice to continue the use of d-c power for this type of face equipment.

Higher Voltage Advocated

Since the introduction of this heavy face equipment, many operators, recognizing the limitations of d-c, have gone to a-c power, using a 440-volt grounded "Y" system. However, while this is a big step in the right direction, many have found there are still limitations with 440 volts and are advocating a higher voltage to improve regulation, reduce inrush current, or increase distance of travel on secondary feeders.

At present there are many 250-hp Goodman continuous mining machines in operation. These units have a full load input of 305 amp and are equipped with 500 ft of 3-conductor, 4/0 cable. The weight of this cable is 4.2 lb per ft, the diameter is 2.04 in. and it has a rating of 252 amp with a copper temperature of 60°C (140°F) and an ambient of 20°C.

In comparing the rating of the cable with the input to the motor, it is found that even at this weight, which the machine operators say is excessive from a handling viewpoint, that the cable is only good for 80 percent of the motor rating at the specified copper temperature.

When faced with a condition of this nature, and where the motor is actually developing its rated horsepower, it means that not only is the cable operating at a temperature which greatly reduces its life but the system regulation is greatly affected.

Because machine operators are now complaining about the weight of the cable, and would be very reluctant to handle anything heavier, and in cases where poor regulation is the result of insufficient cable capacity, it seems there is only one answer and that is to decrease the ampere input to the motor by increasing the voltage.

Should it be found necessary to raise the voltage, a great deal may be gained by going to 550 volts. With this higher voltage, the amperes per horsepower are reduced approximately 20 percent and this could be a major factor where cable heating, regulation or inrush current is a problem. Other factors much in favor of 550 volts are that it is a recognized standard voltage and motors and control may be purchased at the same price as the 440-volt equipment.

In view of the many advantages to be gained by 550 volts, it will undoubtedly be given some consideration in the near future where conditions are beyond the scope of 440 volts.

Use of 2300 Volts Poses Many Electrical Problems

There has been some talk of going to a higher voltage than 550 and this will be necessary if the manufacturers of mining machinery continue to raise the horsepower. If and when this time comes, because there is no standard voltage between 550 and 2300 volts, the higher voltage will probably be considered. There has also been some talk of going to a voltage of approximately 1100 in West Virginia. The reason for this is that with a grounded "Y" system the voltage from phase to ground would be within the State law limit of 650 volts.

However, it is felt that if the time ever comes when the mining industry has to go beyond 550 volts, the manufacturers of electrical equipment will balk at anything less than 2300 volts. They will not want to establish another voltage between those values.

If the manufacturers do continue to raise the horsepower and it becomes necessary to go to 2300 volts, there will be many electrical problems to solve. These will consist of motor design, the design of control which, of course, will be much larger, higher short circuit current, and the safety of operation.

There is a distinct possibility that the day of this high voltage may not be too far distant.

Education of the Mining Engineer

By WALFRID BEEN

Professor and Head, Dept. of Mining Engineering, Michigan College of Mining and Technology

Problems facing the next generation of mining engineers will require more intensive specialization than that which characterizes the classical concept of a mining engineer. The author discusses some new concepts of engineering education which he feels will help future mining engineers to cope with their problems

THERE have been analyses made in recent years of the demand for mining engineers, in the light of the professional environment in which mining engineers are performing today. However, this article will attempt to deal with the need for mining engineers in terms of what they must be doing in the next few years.

There is a vast difference between demand and need. Surveys, upon which an estimate of demand is made, can determine the number of engineers required to fill vacancies as incumbents move up or out. But the need is going to be for men who can cope with problems, which have only lately begun to be recognized as critical ones, in the future mineral supply of the world.

In order to establish a point of departure for an estimate of our future direction, it might be well to review the progress of the profession up to now. There is no question that progress in mining has been made, but much of it has been in the application of power to old and classical unit operations. Drilling, mucking, and hauling are all being done with bigger and more powerful devices. To assist the mining engineer in the realization of these improvements, the services of mechanical, electrical and industrial engineers were required. These engineers responded so well and with such good results that there are those who question whether there is any need for mining engineers at all.

Mineral Supply Situation Changing

This attitude is quite logical, if the mineral supply situation is viewed as a static one, and it is assumed that further prospecting will result in discovery of more mineral reserves of the type that have been worked to date. Several recent studies indicate that this assumption is not the case. The head-on collision course that exists between the mineral demands of an exploding world population, and satisfaction of this demand from an ever-diminishing area of search, is going to require mining minerals from environments which today are considered impossible. When those happy accidents of nature, that have provided us with concentrations of minerals in nicely defined masses, can no longer be discovered it will be necessary to return to areas that are presently too deep, too erratic, too disseminated, or too refractory to handle. This will intensify problems of extraction and will force us to perform in the realm of design and control of systems that may yet have to be invented.

Properties of rocks under confining forces, effects of pressure release due to mining, the plastic and viscous flow of rocks in deep mining are examples of matters that need intensive study. And conversely, these same properties must be studied for fragmentation for mining. Measurement of stresses and strains and designing the necessary instruments for dealing with these matters are other areas needing study.

On the operating side, problems of materials handling are going to have to be more thoroughly studied. For valuation and operating purposes, more accurate analysis of sample data in estimating size, shape, quality, and mineral distribution of ore bodies is going to be necessary as lower grade and more erratic deposits are mined. Finally, economic studies, that will be required to optimize a system for achieving lowest cost, highest extraction, or greatest profit, will provide opportunities in operations research that will be a challenge to the most vigorous and visionary minds.

What Must Engineering Colleges Do?

The above examples are enough to indicate that mining engineers are certainly going to be needed. The engineers who have helped mechanize the classical methods are not going to solve these design problems; these are particular and intimate problems of mining engineers.

With the problems of engineering indicated, we can now consider the matter that we started out to discuss: What must mining engineering colleges do to prepare men who can effectively meet these challenges?

It is obvious that the basic sciences that will enter into analysis of these problems are going to have to be quite different from the spread of interest that has occupied the mining engineers of the past. In the area of rock mechanics, the student must be prepared with more rigorous mathematics, engineering mechanics, and properties of materials. Three-dimensional stress analysis requires intensive preparatory work as does wave-propagation analysis which enters into fragmentation studies. Geophysics of rock environment, that must be learned in order to achieve actual design, is a challenging field.

In the operating-engineering area, statistical analysis of data needs attention. Mathematics of operations research, required to deal with many problems of systems design and evalution, can occupy a large part of a four-year college course. No one student can hope to become learned

The widely held notion that a mining engineer is a jack-of-all-trades has resulted in his being trained in several techniques at the expense of real depth of learning in any one of them

in all these areas, yet, nothing has been said of the customary spread of the mining engineer's interest in the whole field of mineral exploitation, from prospecting to refining.

On the other hand, exploration geophysicists, geologists, ore dressers and metallurgists have long been happy to view their particular fields as exclusive professions. In the mining engineers' attempt to superficially cover a wide spread of interest, he has been neglecting the one area in which he alone can make significant contributions.

Some Courses Will Have To Be Deleted

In the design of a college curriculum, we can be fairly confident about the science studies that ought to be added, and what research ought to be done, to form a foundation for the engineering capability desired. It is quite another matter to delete courses. This subject should be approached with caution. But the four-year bachelor's curriculum has always been full and any additions must be accompanied by deletions. In our particular college we are committed to a four-year program for two reasons: First, for many students the law of diminishing returns begins to operate, and after four years "they have just about had it." This does not mean that they are incompetents, but they are better off getting into operations than they would be to spend more time in the academic atmosphere. Secondly, by the time a boy approaches his junior or senior year, he ought to have discovered his most stimulating field of interest and he should pursue this specialty at graduate level if he is capable of doing so.

So, with four years to fill, the problem remains of what can be taken out in order to get more in. There are two places to search for this room. First, consider the diversification of which we spoke—how much time should be spent on ore dressing and metallurgy, for instance? The author believes a one-term survey course in this area is enough. The choice is not as easy in geology and mineralogy—there is room for debate. A facility in mineral recognition may be of little value, but petrology may have significance in studying mechanical properties of rocks. So we need some mineralogy. However this may be decided, and we are not entirely certain; close scrutiny of these auxiliary courses is necessary.

Creativity Necessary In Mining Engineers

In the matter of training of techniques, some room can also be made. Field techniques vary from place to place; furthermore, they are apt to have a high rate of obsolescence, but a discipline in a basic science is a lifetime acquisition. Perhaps at the risk of having the new graduate somewhat vulnerable in his first job, we can ease up in the training of techniques—more "complete" engineers will be developed if it is kept in mind that we are educating for engineering. In speaking of educating for engineering, a definition of the word "engineering" must be given. The design and control of systems of forces and materials for the accomplishment of some useful objective constitutes engineering. The three components of this definition should be emphasized because they will be referred to again: (1) design and control, (2) systems of forces and materials, and (3) a useful objective. The forces may be human forces and the materials may be metals or organizations of men, so that the two words "design" and "control" could be "plan" and "manage," and still be valid by definition. Furthermore, unless there is a useful objective to be achieved, no matter what form the effort, the word "engineering" does not describe it. When viewed in this way, the term "applied science," as used in so many definitions of engineering, describes a means to an end, and does not describe engineering itself. The author has no patience with a definition that implies that engineering is an activity that lies somewhere between scientific research and the practicing of a craft. Engineering is released from this narrow restriction by virtue of its most requisite quality, creativity.

An engineer and a scientist do have a large overlap in their fields of interest. The difference between them is not so much in degree as in motivation. The scientist can feel a sense of accomplishment in the mastery of understanding or in acquiring a new piece of knowledge from research, but engineering does not exist until this knowledge is utilized in creating something of practical utility.

If we can keep this in mind in designing and teaching courses at the engineering college, there is no need to fear that engineering will deteriorate or that a group of impractical theorists will be developed. To fear that these young men will not be able to survey, or draw a map, or do the junior engineering chores, because of intensification, is nonsense. Engineering can hardly be taught without including the essentials of mensuration and graphical communication. But the multitudinous variances of techniques can be learned by the young engineer without the benefit of a college faculty. If he cannot or will not learn, he should be fired forthwith.

If we can instill into the student a discipline in the process of scientific thinking, if we can give him confidence in his problem-solving abilities by insistence on creative design, he can project these qualities into whatever situation the circumstances require, be it the designing of a mining plan or the control of an operating system.

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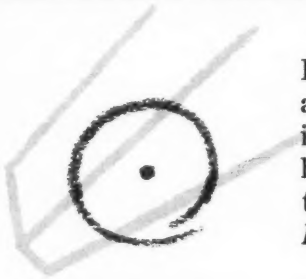

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Positive Application of INDUSTRIAL ENGINEERING TO COAL MINING

By L. J. PRELAZ
Secretary, Coal Standards, Inc.

A case study of Warner Collieries reveals how the effective and positive application of industrial engineering can result in increased efficiency and reduced costs

THE discovery of power and steel during the latter part of the nineteenth century introduced a new era in the industrial revolution. These two great resources provided industry the tools to convert from handicraft to factory production. Managerial problems began to magnify themselves when this new concept of production began to develop. Quality, productivity, supervision, trained personnel, inventory, cost accounting, cost control, and obsolescence were but a few of the problems confronting management. To be assured a place in the increasingly competitive field, management began to analyze each problem scientifically. Over a period of time, new techniques were developed to aid in the successful administration of business affairs. A few of these techniques are:

(a) Mass production through mechanization
(b) Time and motion study
(c) Methods analysis
(d) Equipment analysis
(e) Inventory control
(f) Cost accounting
(g) Cost control
(h) Wage incentives

Are these techniques adaptable to the coal industry?
Yes.
Why has the industry been so slow to utilize them?
Principally because there has been no great need for this approach until recently.

Need to Change Management Techniques Is Increasing

Using one coal producing state as an example: In 1935 ony two percent of all the coal mined in West Virginia was loaded mechanically. By 1940, 35 percent of total production was produced in mechanized mines. By 1950 this figure had increased to 74 percent and today more than 90 percent is mechanically loaded. The 1940's were the prosperous years for the coal industry when the selling price of coal was excellent and a profit margin could be maintained whether coal was produced mechanically or by hand-loading methods. Consequently, there was no great need to change management techniques. Even during the present decade several fruitful years were experienced.

As mines are being completely mechanized, and competition is becoming keener, the coal industry is beginning to experience the same problems faced by other industries a half century earlier. New and faster machines are designed every year, labor and supply costs are increasing, equipment becomes obsolete before the original cost is amortized, and large amounts of capital remain dormant in warehouse inventory. These are but a few of the problems facing management as the selling price of coal continues on a downward trend. Stiff competition is beginning to take its toll.

To combat the increased costs, several coal companies have resorted to different management techniques to solve their problems, some have invested in the most modern machines, while others have applied both, different techniques and capitalization.

Cost Reduction Program Nearly Doubles Productivity

This article will briefly discuss the application of some of these new techniques as developed by one coal company when a cost reduction program was initiated in 1952.

Figure 1 graphically illustrates the results obtained in labor cost reduction during a period of eight years.

The year 1951 is used as comparison base. The percent increase in base wages and vacation pay are plotted through the year 1958. (Vacation pay per day is based on 200 work days per year). The percent decrease

in actual labor cost, which includes union labor, supervision, and vacation pay, are also plotted through 1958. During these years base wages increased 36 percent while the actual labor cost decreased 28 percent. In terms of productivity, this represents an approximately 90 percent increase from 1951 through 1958. Annual production is recorded with the respective year. These results were obtained with minimum capitalization. Three mobile coal drills were purchased in 1954. In 1957 and 1958 an investment was made in three rubber-mounted cutting machines. This was the only face equipment added to supplement the loading machines and shuttle cars acquired in 1948 and 1949. The average coal operator will recognize this is a small capitalization cost for such a large increase in productivity.

How, then, were these results obtained? There are three reasons.

1. Top management recognized the need for a cost reduction program, initiated it, and gave it full support.
2. Mine management from the superintendent to section foreman level was trained to understand and administer new techniques.
3. An industrial engineering department was organized and trained to evaluate operational problems analytically.

The secret of success manifested itself in the full integration of these three groups who eventually solved phases of each administrative and operational problem.

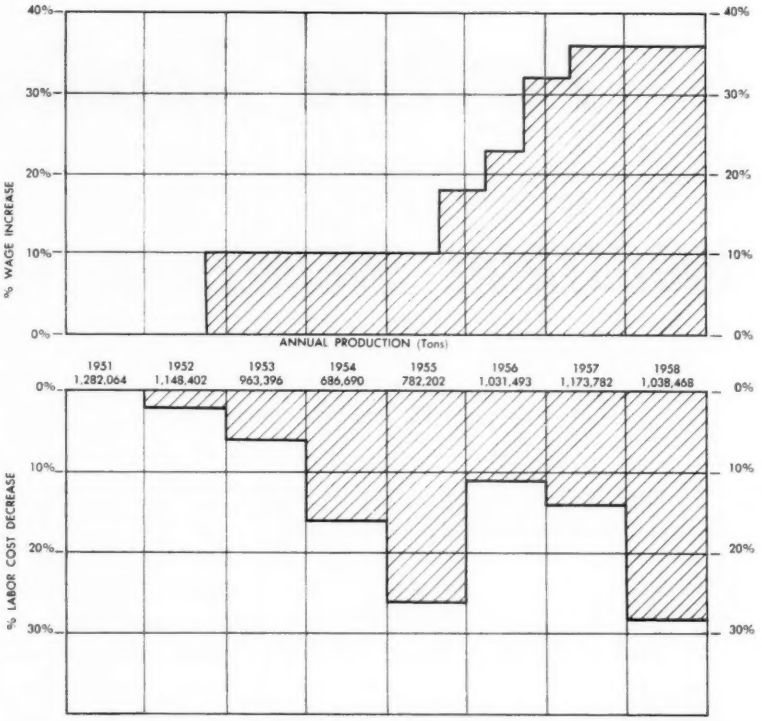

Fig. 1. Warner Collieries initiated its cost reduction program in 1952. Graph shows the results obtained in labor cost reduction, using the year 1951 as a comparison base. Note that base wages increased 36 percent while the actual labor cost decreased 28 percent

Industrial Engineering Department's Approach to the Problem

To describe in detail how this cost reduction program was engineered and administered would require a tremendous volume of facts, figures and illustrations. However, with due credit given to management, without whose effort the program would have been a dismal failure, the approach by the industrial engineering department will be discussed.

The basic functions of the industrial engineering department were to:

1. Measure the potential productive capacity of coal producing equipment.
2. Determine production standards.
3. Evaluate and measure the effectiveness of present and proposed mining methods.
4. Study old and new equipment and evaluate machine performance under different mining conditions.
5. Conceive and perpetuate a system of cost accounting and cost control.
6. Measure daily cost and production and evaluate the wastes incurred.
7. Inform management on all phases of operations affecting cost, production and investments.

Following a brief training of supervisors and engineers on the theory of time study, direct time studies were made in the mines. This approach proved unsatisfactory because the results yielded only a record of what was done under specific circumstances and conditions. The effect on production under different circumstances and conditions could not be projected by utilizing this method of study.

Standard Data System Adopted

The standard data system was then adopted. This approach involves a complete elemental breakdown of an operation. In this manner each segment of work can be studied separately and the entire cycle determined by the component parts of work elements involved in the operation. Lost motion is easily detected, and conditions more thoroughly evaluated. The difference in the direct and standard data time study would be comparable to a yard stick calibrated in inches to one calibrated to sixteenths of an inch. In other words, the finer the degree of measurement, the higher the degree of accuracy.

Each face operation—cutting, drilling, shooting, roof support and loading—was broken down into elements of work, time studied, and standards determined. Once the studies were completed, these elemental times were analyzed and old and new methods evaluated. Just as a mining machine is designed to a high degree of mechanical and electrical perfection, entire mining plans were designed for maximum production with the proper crew and equipment balance in varying mining conditions.

Figure 2 is an illustration of a work method cumulated with elemental times. This particular operation involves a helper on a shortwall cutting machine and is co-ordinated with the cutting operation.

The loading standards were the most difficult to develop because several units of equipment are worked simultaneously. Conditions affecting one unit of equipment control the effectiveness of other units. Coal loading is a materials handling problem under restricted and varying condi-

tions. Basically the operation involves the loading of a small volume of material, at a specified rate, in a specified time, and conveyed a specified distance. If volume, speed, distance, or time varies, because of conditions, mining methods, or equipment, the standard cycle time is changed. To illustrate the effect on a loading cycle, when elements or standard values are altered, figure 3 is presented.

A loading standard is based on the following elemental and standard values.

ELEMENTAL STANDARDS AND VALUES	UNITS
Load loose coal	0.34 min/ton
Load stand coal	0.40 min/ton
Load rib coal	0.50 min/ton
Load pile coal	0.50 min/ton
Short maneuver	0.21 min/maneuver
Long maneuver	0.33 min/maneuver
SC speed	0.04 min/10 ft
SC discharge	1.00 min/SC
SC capacity	3.71 tons/SC
Haul distance	300 ft
Change out distance	80 ft
Loader constant	4.00 min

The total standard cycle time to load 26 tons of coal with these specified standards is 22.07 minutes. By decreasing and increasing the loadability element 25 percent, with all other values remaining the same, the loading cycle time is decreased and increased 6.7 and 6.8 percent respectively. By changing the shuttle car capacity in the same proportions, with all other values remaining the same, the loading cycle time is increased and decreased 18.6 percent and 12.1 percent respectively. Changes in shuttle car speed, shuttle car discharge, haul distance and change out distance are also evaluated. The last two columns indicate the compounding effect on the loading cycle when the standard values are all changed favorably or unfavorably.

The question may be asked, "How did this approach reduce cost?" The answer is, "Old methods, equipment and conditions were measured and new methods, equipment and conditions evaluated."

This system has provided a sound basis for measuring the effect on production by shooting mediums, face preparation, power, roof falls, grades, equipment malfunctions, haulway conditions, equipment design, etc. Detailed analyses have prompted changes in mining plans and mining methods to conform to seam conditions, equipment modifications, crew standardization, preventive maintenance, equipment concentration or dispersement, selection of new equipment, mainline haulage conversion, selection of materials, etc. All of these factors have contributed to the overall cost reduction.

Ultimately standards were developed to measure the performance of men and equipment under varying mining conditions and methods.

Cost Accounting System Streamlined

The next progressive step was directed toward the development of a cost accounting and cost control system. Heretofore the indicated daily actual costs were erratic and unreliable. An accurate cost accounting

CUTTER HELPER

Element Description	Elemental Time (Min.)	Cumulative Time (Min.)	Element Description	Elemental Time (Min.)	Cumulative Time (Min.)	Element Description	Elemental Time (Min.)	Cumulative Time (Min.)
Tram	2.55	2.55	(Wait)	(0.04)	6.02	Auger out	0.13	13.32
Two 90° turns	0.36	2.91	Walk 15 ft	0.07	6.09	Drill and auger up	0.09	13.41
Unload head cable	0.08	2.99	Unload drill	0.06	6.15	Drill top hole No. 4	0.78	14.19
Unload pick	0.03	3.02	Carry drill 0.55M/100	0.09	6.24	Drill and auger out	0.13	14.32
Pick aside (pitch to rt. rib)	0.03	3.05	Pick up auger	0.06	6.30	Disconnect drill and auger	0.02	14.34
Pick up axe	0.03	3.08	Connect drill and auger	0.08	6.38	Carry drill 15 ft	0.08	14.42
Walk 10 ft	0.05	3.13	Drill bottom hole	0.62	7.00	Drill aside	0.05	14.47
Test top-150 sq ft	0.50	3.63	Auger out	0.13	7.13	Load Schroder hose	0.31	14.78
Walk 15 ft	0.08	3.71	Drill and auger up	0.09	7.22	Walk 5 ft	0.03	14.81
Axe aside	0.03	3.74	Drill top hole No. 6	0.78	8.00	Tighten rope	0.14	14.95
Pick up jackpipe	0.06	3.80	Auger out	0.13	8.13	Unload shovel	0.04	14.99
Jackpipe aside	0.06	3.86	Drill and auger over	0.14	8.27	Walk 15 ft	0.07	15.06
Walk 15 ft	0.08	3.94	Drill bottom hole No. 7	0.62	8.89	Shovel aside (lt. rib)	0.03	15.09
Pick up pick	0.03	3.97	Auger out	0.13	9.02	Position T2 truck	0.45	15.54
Stamp No. 1 and 2 holes	0.25	4.22	Drill aside	0.05	9.07	Walk 15 ft	0.07	15.61
Walk 5 ft	0.03	4.25	Walk 15 ft	0.07	9.14	Pick up shovel	0.04	15.65
Stamp No. 3, 7 and 4 holes	0.25	4.50	Pick up jackpipe	0.06	9.20	Shovel lt. rib	4.96	20.61
Walk 5 ft	0.03	4.53	Set jackpipe	0.10	9.30	Walk 5 ft	0.03	20.64
Stamp No. 5 and 6 holes	0.25	4.78	(Wait)	(0.04)	9.34	Shovel aside	0.03	20.67
Walk 5 ft	0.03	4.81	Walk 15 ft	0.07	9.41	Pick up jackpipe	0.06	20.73
Stamp No. 7 and 8 holes	0.25	5.06	Pick up drill and auger	0.07	9.48	Set jackpipe	0.10	20.83
Walk 25 ft (carry pick)	0.12	5.18	Drill and auger up	0.09	9.57	(Wait)	(0.04)	20.87
Pick aside (on mach.)	0.03	5.21	Drill top hole No. 8	0.78	10.35	Walk 14 ft	0.07	20.94
Unload drill hose	0.13	5.34	Auger out	0.13	10.48	Remove tail jack	0.10	21.04
Walk 5 ft	0.03	5.37	Disconnect drill and auger	0.02	10.50	Pitch jackpipe	0.06	21.10
Clevis off and aside	0.04	5.41	Carry drill 18 ft	0.10	10.60	Walk 14 ft	0.07	21.17
Walk 10 ft	0.05	5.46	Connect drill and auger	0.08	10.68	Load loose cable	0.37	21.54
Pick up jackpipe	0.06	5.52	Drill bottom hole No. 1	0.62	11.30	Walk 15 ft	0.07	21.61
Set jackpipe	0.10	5.62	Auger out	0.13	11.43	Rope to T2 truck	0.05	21.66
(Wait)	(0.04)	5.66	Drill and auger up	0.09	11.52	Maneuver T2 truck	0.39	22.05
Walk 15 ft	0.07	5.73	Drill top hole No. 2	0.78	12.30	Controller off. Load head cable	0.13	22.18
Pull rope 15 ft	0.09	5.82	Auger out	0.13	12.43	Pick up jackpipe	0.06	22.24
Pickup jackpipe	0.06	5.88	Drill and auger over	0.14	12.57	Jackpipe aside	0.06	22.30
Set rt. jackpipe	0.10	5.98	Drill bottom hole No. 3	0.62	13.19	Clevis on	0.08	22.38

Fig. 2. An illustration of a work method cumulated with elemental times. This particular operation involves a helper on a short-wall cutting machine and is co-ordinated with the cutting operation

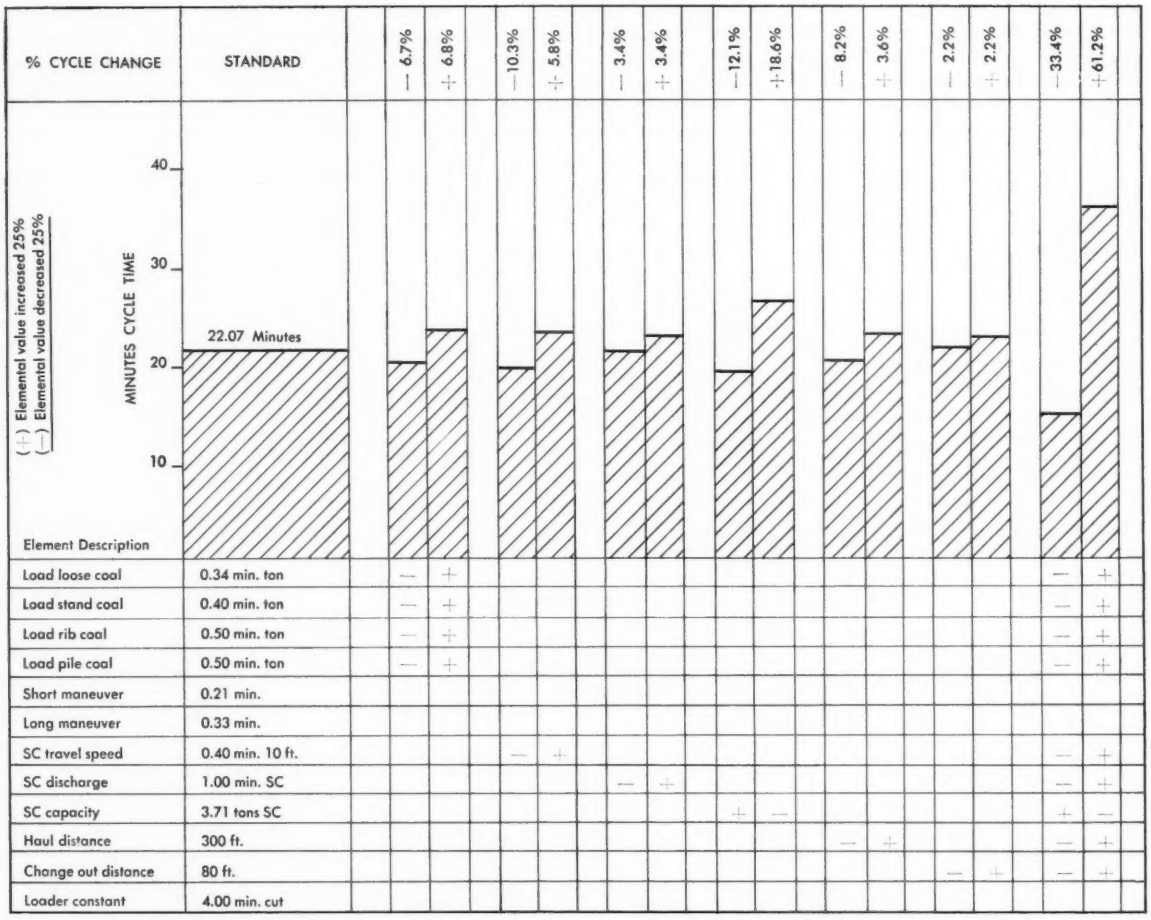

Fig. 3. Coal loading is a materials handling problem under restricted and varying conditions. Basically the operation involves the loading of a small volume of material, at a specified rate, in a specified time, and conveyed a specified distance. If volume, speed, distance or time varies, because of conditions, mining methods or equipment, the standard cycle time is changed. The above chart is presented to illustrate the effect on a loading cycle when elements or standard values are altered. Note that the total standard cycle time to load 26 tons of coal with these specified standards is 22.07 minutes. Let us consider a particular example. By decreasing and increasing the loadability element 25 percent, with all other values remaining the same, the loading cycle time is decreased and increased 6.7 and 6.8 percent respectively. Changes in other items are also evaluated. See text for a more complete description of chart and how this approach reduced costs at Warner Collieries

system was of prime importance before daily cost control could be exercised.

Basic requirements for developing such a system are:

1. An accurate means of determining the daily actual salable production from each mining area.

2. An accurate means of determining the potential production capacity from each mining area.

3. A means of gathering and classifying all actual costs and allocating these charges to the respective operations incurring the costs.

4. A means of estimating and projecting costs so that a standard cost could be determined.

5. A means of evaluating the difference between standard and actual costs, commonly referred to as a waste cost.

Reports and records were systematically designed to simplify the collection, interpretation and presentation of all actual and standard cost and production data.

Ultimately the cost accounting system was streamlined to such a degree of perfection that the daily cost was resolved into a profit and loss statement for each coal producing section. The basic requirements for daily cost control were fulfilled.

Cost Controls Spotlight Trouble

Evaluation of waste was the greatest benefit derived from the system. Once the potential production capacity was determined through standards, a standard cost was established for each coal producing section. This standard cost provided a means of evaluating waste, which is the difference between actual and standard cost. The underlying theory is that a productive capacity exists for any type of equipment in certain conditions when operated by a standard crew. If the capacity has not been attained, there are reasons for this variance and a dollar value can be placed on the variance.

A cost control system was designed to identify, isolate and evaluate all daily waste costs. Theoretically, elimination of waste represents a reduction in cost. Total elimination of waste is practically impossible, both physically and economically. However, if certain wastes can be eliminated physically and economically, their reduction will yield a lower cost.

Figure 4 shows a condensed

monthly waste report as compiled and accumulated daily for mine management.

Cost controls focus and spotlight trouble and guide management into a position from which it can evaluate and eliminate any discrepancy affecting cost and production. Costs can be reduced by changing methods, equipment, etc., but cost control provides a finishing tool to obtain the ultimate in cost reduction.

Standards, methods and cost control are a few of the tools that have been designed and developed for management through industrial engineering. The method with which management applies these tools spells either success or failure. An industrial engineering department can only function effectively when management gives it full support. Positive application of industrial engineering is not applied by the industrial engineering department but through it. The records on cost and production are the final proof of success or failure. In the case of this coal company the records indicate success because management applied industrial engineering positively and effectively. Industrial engineering only provided the tools for positive application through positive engineering.

OPERATIONAL WASTE AND DELAY REPORT
DECEMBER 1958

	Section 1	*Section 2*	*Section 3*	*Section 4*
Loader No. 1				1,163
Loader No. 2			80	
Loader No. 3		198		
Loader No. 4	357			
Loader No. 5				295
SC No. 1		83		
SC No. 2			30	
SC No. 3			21	
SC No. 4			49	
SC No. 5		122		
SC No. 6	29			
SC No. 7	17			
SC No. 8				114
SC No. 9				111
SC No. 10				108
SC No. 11				36
Cutting machine	26	148		12
Drills			69	
Pan line		111		17
No. 1 belt		304	975	2,300
No. 2 belt			811	148
Top	1,505	817	373	991
Draw rock	1,002	72	278	316
Mud and water	106			
Supplies	66	106		
Moving	91	44	100	700
Empties	106	128		
Hoist	41	29		
Power	36	13	104	149
RR cars	106	65	218	
Portal			27	47
Total delays waste	$3,488	$2,240	$3,135	$ 6,507
Substandard waste	$3,335	$ 462	$2,392	$ 3,940
Total waste	$6,843	$2,702	$5,527	$10,447

Fig. 4. A condensed monthly waste report as compiled and accumulated daily for mine management

AMMONIUM NITRATE EXPLOSIVES

continued from page 62

Range, at Iron Mountain in Utah, Anaconda in Montana, and at Michigan Limestone, and it is now in use to an appreciable extent in these and many other locations. The "Procore" #3C booster is a three in.-diam, approximately 5/6-lb booster that has unlimited water resistance, cannot be detonated with a 3000 fps rifle bullet, and is theoretically the ultimate in safety because its Primacord- and cap-sensitive element is buried inside the booster, the outer, main charge being cap- and Primacord-insensitive. IRECO also manufactures a two-in. diam ("Procore #2A") booster having all of the advantages of the larger #3C booster (Fig. 4). The "Procore #2A" booster is about one-third of a pound and has almost exactly the same boostering action as the "Penta Mex" (160 gm cast 50/50 pentolite) in use at the Labrador-Quebec operation of IOCC. It sells for about 70 percent of the price of the "Procore #3C" booster, and while it is not as powerful as the "Procore #3C", it still has a very adequate margin of safety for initiating detonation in all of the insensitive open-pit blasting explosives currently in use, including "prills and oil" and slurry explosives. Its high brisance, complete water resistance, ease of handling, and very attractive safety characteristics should provide a very satisfactory boostering system for these insensitive type explosives. It is recommended, therefore, that operators look carefully into these and similar type boosters in order to place their operations on a safe and reliable standard.

Acknowledgement: The experimental results given in this article were obtained mostly by IRECO in a program supported by the Iron Ore Company of Canada.

REFERENCES

1. Discussions at Sixth Annual Drilling and Blasting Symposium, University of Minnesota, 1956.
2. D. M. Stromquist, "Better AN Loading = Even Lower Costs," *Engineering and Mining Journal*, October 1958, page 90.
3. "How Anaconda Automatically Assays Jackpile U_3O_8 Ore for Grade Control," *Mining World*, October 1958.
4. H. E. Farnam, Jr., "The Developments in the Use of AN Explosives in Canada," Eighth Annual Drilling and Blasting Symposium, University of Minnesota, 1958.
5. S. R. Brinkley, Jr., and W. E. Gordon, "Explosive Properties of the Ammonium Nitrate-Fuel Oil System." Congrès International de Chimie Industrielle, Liege, 1958.
6. M. A. Cook, "The Science of High Explosives," Reinhold Publishing Co., New York, 1958.
7. ————, "Large Diameter Blasting with High AN; Non-NG Explosives," Third Annual Symposium on Mining Research, Missouri School of Mines and Metallurgy, No. 95, November 1958.
8. ————, "Theory and New Developments in Explosives for Blasting," Sixth Annual Symposium on Drilling and Blasting, University of Minnesota, 1958.
9. ————, "Water-Compatible AN Explosives for Commercial Basting," Fourth Annual Symposium on Mining Research, Missouri School of Mines and Metallurgy, 1958.
10. J. F. C. Dixon, "Developments of Physical Properties and Techniques Suitable for Commercial Applications of Slurry Explosives," Fourth Annual Symposium on Mining Research, Missouri School of Mines and Metallurgy, 1958.
11. H. E. Farnam, Jr., "Large Scale Use of AN Slurries by Iron Ore Company of Canada," Fourth Annual Symposium on Mining Research, Missouri School of Mines and Metallurgy, 1958.
12. M. A. Cook, "Properties and Characteristics of Ammonium Nitrate as an Explosive," 42nd Annual Convention, National Crushed Stone Association, Miami Beach, Fla., 1959.

L-P-F PROCESS at the Ray Concentrator

Over two years of operational experience with the Leach-Precipitation-Flotation process has demonstrated it to be a workable, effective process for improving recovery of copper from semi-oxidized ores

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IN 1955, Kennecott Copper Corp. announced plans to modify its Ray Mines Division concentrator, located at Hayden, Ariz., to provide the facilities for treating the Ray ore by a Leach-Precipitation-Flotation process, commonly referred to as the L-P-F process. The installation of process equipment in the mill and the construction of an acid plant and sponge iron plant were completed late in 1956 at a cost of approximately $5,000,000. The L-P-F process has now been on stream for approximately two and one-half years, treating an average of approximately 16,000 tons of ore per day. Recently, Kennecott has announced that milling capacity of the Ray concentrator will be increased by 50 percent; L-P-F processing facilities will be correspondingly increased as a part of this expansion program.

There has been widespread interest in the L-P-F process as it is used at the Ray Mines Division. In 1957, a brief description of the process was published; however, at that time plant construction had just been completed and no operation data were available. The purpose of this article is to review the process in the light of over two years of plant operation, and from the experience gained, to evaluate, to a limited extent, the general applicability of the L-P-F process to the treatment of semi-oxidized copper ores.

The Leach-Precipitation-Flotation process has proven to be a metallurgical success in the treatment of Ray ore. Adoption of the process and justification of the capital expenditure for the plant facilities at Hayden were based on laboratory test results which had indicated that with an "average" Ray ore, containing 0.27 percent nonsulfide copper, L-P-F processing would improve copper recovery by an additional two pounds per ton, as compared with the recovery possible by a conventional xanthate flotation process. Operational data, from the past two years' operation, indicate that this increase in recovery is being attained or surpassed in the Ray concentrator. Unfortunately, the Ray

concentrator does not have an isolated test section and a direct comparison of the effectiveness of the process as compared with prior practice under test conditions is not possible. However, previous operating experience had established the relationship fairly closely between copper recovery and nonsulfide copper content of the Ray ore. This experience and accumulated data provides a sound basis for appraising the benefits attributable to the L-P-F process. Since the installation of the L-P-F process, copper recovery has been increased from approximately 75 percent to over 85 percent; this increase in recovery has been due primarily to the increased recovery of nonsulfide copper by the L-P-F treatment process. One other benefit is being derived from the L-P-F process; that is the ability to mill effectively high-nonsulfide, acidic ore that otherwise would be placed on waste or leach dumps because of low copper recovery or high lime consumption.

The L-P-F process is not new. The basic process steps of leaching nonsulfide copper minerals with sulfuric acid, precipitating the copper taken into solution as a finely divided metallic sponge, and recovering this sponge copper by flotation has been known for many years and has been employed by several copper mining companies. This basic milling process has been modified and adapted to meet the special mineralogical characteristics of Ray ore.

Ray Ore Mineralogy

In common with many of the Southwest copper deposits, the Ray orebody has been subjected to considerable oxidation and alteration of the copper minerals. The host rock is a schist, with intrusions of quartz-porphyry and diabase. The latter is important to the L-P-F process primarily as a source of pyrite, but contains insufficient nonsulfide copper to warrant L-P-F processing. In the schist ore, the principal copper mineral is chalcocite, which occurs primarily as a replacement coating on pyrite. Nonsulfide copper minerals in decreasing order of abundance are copper silicates (chrysocolla), cuprite, malachite, tenorite and native copper. Cuprite and tenorite are associated with the sulfide minerals and with native copper. Generally, a good recovery of these minerals can be obtained in a conventional xanthate flotation process. The copper silicates and carbonates occur principally as coatings on sulfide grains and along seams and fissures in the gangue rock. The L-P-F is aimed primarily at recovery of this silicate and carbonate copper. Localized within the orebody are caved areas from past underground mining operations. In this broken ground, sulfate copper is often encountered in appreciable quantities. In general, the silicate and carbonate copper minerals are concentrated either in slimes or upon the surface of rock particles by crushing and grinding; this is important in the L-P-F process since it permits leaching to be conducted at a relatively coarse size.

Within the Ray orebody there are variations in mineralogy. The degree to which pyrite has been replaced by chalcocite is variable, as is the ratio between sulfide and nonsulfide copper minerals. As an average, the Ray ore contains about 20 percent of the copper in the form of nonsulfide minerals, but in day-to-day operations this "average" ore feed is seldom attained. Consequently, one of the major problems has been the scheduling of mining operations so as to provide a reasonably balanced mill feed with respect to sulfide copper, nonsulfide copper and pyrite content. The Ray Mines Division's mining department has been very successful in establishing the required control of mining operations to meet the requirements of the L-P-F process.

L-P-F Process

A line flowsheet for the Ray L-P-F process is presented in Figure 1. The L-P-F process can be considered as beginning with a minus three mesh rod mill product. In each of the four mill sections, this product is deslimed at approximately 200 mesh using 24 ft Dorrbowl classifiers and liquid cyclones. The sand fraction is leached with sulfuric acid, at a pH of 1.5–1.7, in a 12 ft by 20 ft leach drum. Contact time in the drum is approximately ten minutes, after which time the leached sand product is washed, countercurrently, in two acid-proof rake classifiers. Washing classifier overflow, which contains copper sulfate leached from the ore and excess sulfuric acid, is combined with the initial slime fraction of the ore removed in the desliming step and this slime pulp constitutes the feed to the acid treatment circuits. Leached and washed sands are ground in the presence of lime and provide feed to the sulfide copper recovery circuit. Approximately 25 weight percent of the ore and 30 to 35 percent of the copper report to the acid treatment circuit.

The acidic, slime fraction of the ore from each of the four mill sections is combined and pumped to a slime leaching tank to which additional sulfuric acid is added in sufficient quantities to maintain a pH of 2.0–2.2. A retention time of approximately 40 minutes is provided; this is sufficient to leach completely all carbonate and silicate copper minerals present. The pulp flows from the slimes leach tank to four parallel banks of precipitator cells, to which is added minus 35 mesh sponge iron. Precipitation of the copper is completed in about ten minutes; the precipitation reaction increases the pH of the pulp to about 3.5. By the oxidation-reduction reaction between copper sulfate and metallic iron, the copper is precipitated as a very fine copper sponge, having a well defined dendritic crystal form. The pulp is then conditioned with Minerec A and pine oil and enters the rougher flotation cells. After removing the rougher concentrate, the rougher tailings are re-conditioned with additional reagents and subjected to a scavenger flotation step. Rougher and scavenger concentrates are combined for a single stage of cleaning which produces a concentrate containing 25 to 30 percent copper. Scavenger tailings are classified with a wet cyclone and the sand fraction cleaned by wet magnetic separators to recover residual sponge iron, which is re-circulated to the precipitation cells. Scavenger tailings generally contain from 0.10 to 0.15 percent copper and about 0.01 gram per liter soluble copper.

The sulfide treatment circuit is conventional and consists of separate flotation recovery of copper and pyrite concentrates from the leached and ground sand fraction of the rod mill discharge product. Raconite, a crude butyl xanthate, is employed as a collector and pine oil as a frother in a flotation pulp maintained strongly alkaline with lime. Pyrite concentrates are produced from the copper flotation tailings by activating the mineral by "scrubbing" in a cyclone and by the use of additional collector. After produced from the copper flotation tailings by activating the mineral by "scrubbing" in a cyclone and by the use of additional collector. After sampling, the sulfide and sponge copper concentrates are combined and pumped to the smelter and the pyrite concentrates pumped to the sponge iron plant.

Sponge iron is produced by calcining the pyrite concentrate in a fluid-bed roaster, reducing the iron oxide

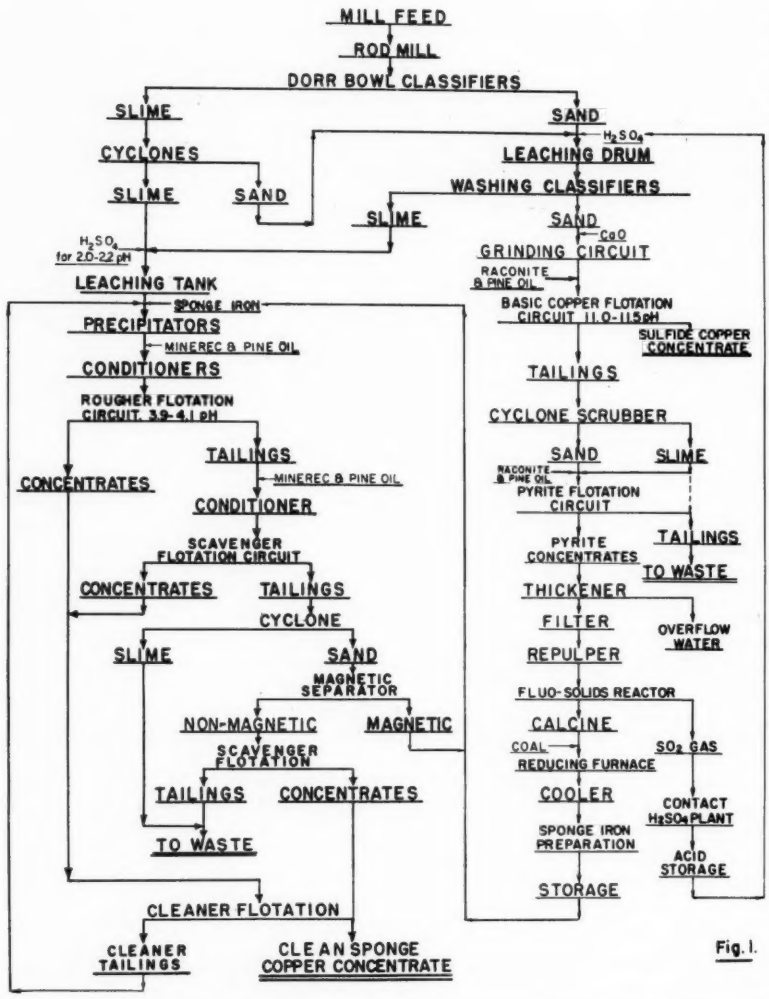


Fig. 1.

Contract afforded by ten minutes retention in the leach drum dissolves about half of the non-sulfide copper from the coarser fraction of ore and over half the silicate and carbonate copper—combined with extraction from slimes, approximately two-thirds of the non-sulfide copper is dissolved in the leaching step

calcine with coal in a gas-fired Bruckner, kiln type, furnace cooling the product, and crushing to 35 mesh. Sulfur dioxide gas from the roasting operation is converted to sulfuric acid in a 100 TPD contact acid plant. A sponge iron product containing over 40 percent metallic iron is currently being produced for use as a precipitant in the L-P-F process.

Metallurgical Factors

The treatment process illustrated by the flowsheet of Figure 1 and outlined above was developed, principally at Kennecott's Research Center, to meet the special characteristics of Ray ore. However, consideration of these factors may serve as useful guides to additional applications of the L-P-F process in the copper industry.

One important factor in the L-P-F is ore leaching characteristics. The leaching procedure developed for the Ray ore was a compromise, being only a partial leach. Complete dissolution of nonsulfide copper from the ore at a relatively coarse size would have required extending leaching times—probably of the order of several days. Leaching at a fine size would have improved the rate of dissolution of copper but would have involved treatment of a much higher tonnage of solids in the acid treatment circuit and possibly the employment of agitation leaching. Laboratory testing indicated excellent metallurgical results would be obtained if only partial leach of minus three mesh material was attempted and this type of leach was highly desirable from the standpoint of operations and economics. This procedure permitted recovery of a separate pyrite concentrate from an alkaline flotation pulp, kept the tonnage of material to be processed in acid circuits to a reasonable level, and kept leaching times sufficiently short so that leaching of coarse material in a moving pulp in leach drums was practical. This type of leaching could be successfully applied only because of the preferential fracture of the ore along fissures which contained the readily soluble nonsulfide copper mineral and which consequently exposed the bulk of the nonsulfide copper minerals to direct contact with the acid. Generally, the contact afforded by ten minutes retention in the leach drum dissolves a little less than half of the nonsulfide copper from the coarser fraction of the ore and over half of the silicate and carbonate copper. When this leach extraction is combined with extraction from slimes, approximately two-thirds of the nonsulfide copper is dissolved in the leaching step. Although techniques are available for more complete dissolution of copper minerals, repeated testing demonstrated that the net additional copper recovered was insufficient to justify the cost of the more complicated processing.

Flotation of sponge copper with Minerec has been found to be quite effective, though somewhat sensitive to pH variations. In the processing outlined, acid additions are automatically controlled throughout the acid treatment circuits to produce a flotation feed pulp having a pH of 3.6–3.8 and a scavenger flotation tailing having a pH of not higher than 4.4. Both laboratory testing and mill results show that recovery of copper is decreased if more acidic flotation pulps are employed and that froth characteristics and grade of concentrates are adversely affected by higher pH. At the desired pH range flotation of sponge copper is very rapid, with recovery of all but middling particles essentially complete in five minutes. However, at the Ray concentrator thirteen minutes flotation time is provided to insure a high recovery of slow-floating slime chalcocite present in the pulp. Performance of the acid flotation circuit in the Ray concentrator has proven better than was indicated by laboratory and pilot mill tests. Copper content of tailings is 0.05 to 0.10 percent lower than was

expected, and an expected difficulty in cleaning concentrates to remove entrained gangue has not been experienced. The reason for this indicated superiority of plant scale processing has not been established.

Sponge iron plays an important role in the L-P-F process. Precipitation of copper from solution in the L-P-F by shredded, detinned scrap is possible and has been employed, but the use of finely divided sponge iron has the advantage of carrying metallic iron through the treatment process, thus preventing re-solution of the copper. With sponge iron, copper precipitation is rapid and complete; with only a very moderate excess of precipitant as a circulating load, copper in solution is generally maintained below 0.01 gram per liter in the flotation tailing.

Sponge iron quality also is important to the L-P-F process. At Ray a sponge iron product assaying slightly over 40 percent metallic iron is currently being produced. With this grade of sponge iron product, consumption is at the rate of slightly over two lbs of metallic iron per lb of copper precipitated. Laboratory tests have shown that precipitation efficiency is related to sponge iron grade and that consumption of a sponge iron containing over 60 percent metallic iron would be at the rate of 1.5–1.6 lbs of metallic iron per lb of copper precipitated. At the present time, the sponge iron plant at Ray is being modified to prevent reoxidation of sponge iron as it is discharged from the Bruckner furnaces. When completed, sponge iron containing over 50 percent metallic iron is expected to be produced. When this higher quality sponge iron becomes available, iron consumption should be decreased significantly, and some improvement in control of the precipitation step should be noticeable, particularly less difficulty in maintaining pulp pH at the desired levels.

Reagent consumption in the Ray L-P-F process has been very close to that indicated by laboratory tests. Sulfuric acid consumption is approximately eight lbs per ton of ore milled; Minerec A and pine oil consumption are, respectively, 0.20 and 0.10 lbs per ton of solids in the acid treatment circuit. Sponge iron consumption averages about eight lbs per ton of ore milled, but is quite variable depending upon both nonsulfide copper content of the ore and grade of sponge iron.

Recovery Improved

Over two years of operational experience with the Leach-Precipitation-Flotation process has demonstrated it to be a workable, effective process for improving recovery of copper from semi-oxidized ores. At Kennecott's Ray Mines Division, a plant installation has yielded metallurgical results equal to, or possibly superior to, the metallurgical results indicated by laboratory and pilot mill testing. Indicated average copper recovery is approximately ten percent higher than could have been achieved with the conventional sulfide flotation process which L-P-F supplanted. The process does not yield a relatively constant improvement in metallurgical results as compared with conventional flotation treatment. Rather, increased copper recovery varies with the nonsulfide copper content and may amount to several pounds of copper per ton with highly oxidized ores which, incidentally, yield the poorest recoveries in conventional flotation. By virtue of this factor, the L-P-F process has stabilized, to a considerable degree, the overall percentage recovery of copper in day-to-day milling operations on Ray ore. While mining control is required to provide the pyrite required for the process, considerable variations in nonsulfide content can be tolerated without encountering correspondingly wide fluctuations in overall copper recovery. The successful application of L-P-F processing at Kennecott's Ray Mines Division points to the possibility of further utilization of this process for treatment of other semi-oxidized copper ores, particularly those which contain readily soluble copper silicates and carbonates.

Mine Electrician's Spotting Unit Reduces Spillage in Loading of Shaft Ore

Journeyman electrician Clifford Rucker of the Bunker Hill Co., Kellogg, Idaho has come up with a device which has proven of great value in skip loading operations in the mine.

The device is an electrically operated unit which flashes signals to the hoistman in the upper station, thereby telling him precisely where a skip is at any given time, the Bunker Hill Reporter declares.

The amazing little portable unit fits in between the rails and over a tie. As ore is taken from a chute and loaded into a skip, the increased weight causes the hoisting cable to stretch. This, of course, lowers the skip and it is then that the new mechanism goes into action. As the skip comes into contact with the device, an electrical impulse flashes the signal to the hoistman and he immediately knows the skip is no longer in the correct position under the ore chute. The skip is then raised until the signal clears. This unit operates another signal light which gives warning if the skip goes beyond the loading area.

The Rucker spotter is especially effective in eliminating excess spillage during the loading procedure, which in the past has been a big problem. It also leaves the skip tender with both hands free to operate the chute gate. Previously, the hoistman could only blindly guess how the skip loading was progressing as he slowly raised the cars up the shaft. Flow of ore from the chutes is unsteady. Obstructions can slow or halt the flow of ore just as it sometimes runs freely. But now the hoistman knows where the skip is and when to move it.

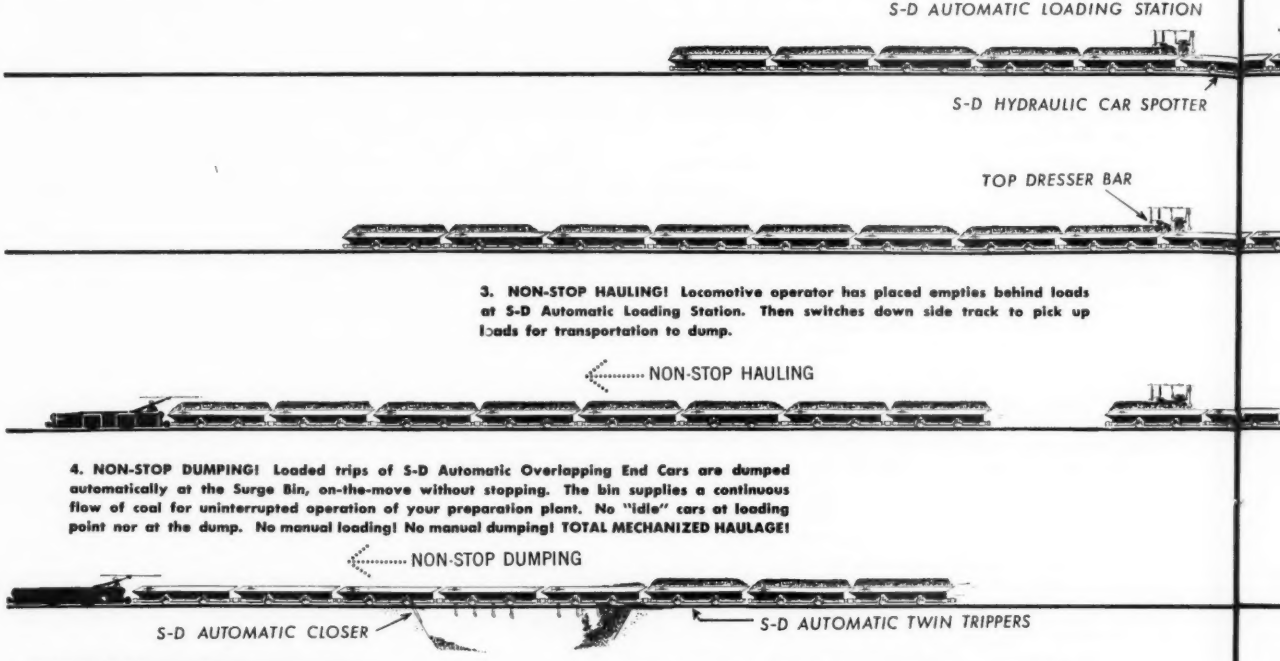
The reduction of spillage in the shaft is a big job the spotter has accomplished, resulting in less cleanup work. Another important advantage of its use is in cutting the wear on the shaft rollers supporting the cable. The whole operation is a good deal safer now, too.

Reprinted from Wallace (Idaho) *Miner*

Our mine car engineers are sure working for you . . .

Now you can eliminate

But that's just the beginning of the enormous savings!



YOU CAN NOW STOP BUYING MINE CARS . . . and START BUYING A HAULAGE SYSTEM that:

(1) provides a constant carrier for your continuous mining efforts to haul the coal away just as fast as it is mined . . .

(2) keeps a constant supply of coal available in Surge Bin for continuous and uninterrupted operation of your preparation plant . . .

(3) operates with minimum labor and minimum maintenance.

(4) requires low initial capital investment and operates at low cost per ton of production.

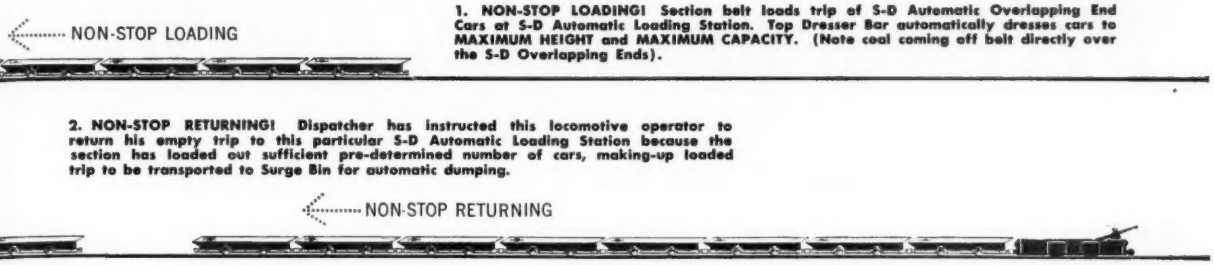
As you have already noted in illustration above, it makes no difference whether an S-D Automatic Overlapping End Car is in trip enroute to or from the dump . . . or in a trip being loaded . . . or in trip rolling across the dump to be emptied (and it has to be at one of those places AT ALL TIMES) — the car and the trip it is in are constantly and continuously AT WORK!

Here is what happened in actual loading of mine cars before our engineers developed the S-D Overlapping End Car, which provided practical and effective application of Automatic Loading Stations. Conventional cars were loaded in series of uneven "heaps" or surcharges, some of which were higher than roofing limitations — causing spillage and further, not providing level-width across top of surcharges to natural angle of repose for maximum loads, and also resulting in a hill-and-valley partial load.

NOW, since the development of the S-D Automatic Overlapping End Car, mine operators are installing a simple cross-bar or U-shaped-bar equal in height above rail to their minimum haulageway roof clearance. This is installed just beyond belt-head. The limit switch controls at the automatic loading station are set to permit each car to be loaded higher than haulageway clearance. Then, the Top Dresser Bar, as it is called, scrapes off the surplus, spreading the material sideward and also leveling the "humps" as loaded car moves under it. When end of car (and there may be some question whether S-D Overlapping End Cars have ends) is moved under this Dresser Bar, the surplus coal is plowed over the S-D Overlapping Ends into next car coming under belt to be loaded. Consider this for a moment. The only practical method to obtain a MAXIMUM LOAD is to load the car high and scrape surplus from one car to another — and this is done automatically! Movement of car-trips at these Automatic Loading Stations is accomplished by Sanford-Day Hydraulic Car Spotters or Sanford-Day "Brownie" Hoists. On a 10-ton S-D Overlapping End Car, for example, users report that Top Dressing permits them to load another ½ to 1 ton. This PLUS an additional ½ to 1 ton

every 6th car in a trip!

Gather round, gentlemen! Here is also NON-STOP MAXIMUM HAULAGE!



more payload obtained by the S-D Overlapping Ends themselves! SAVINGS? At one mine 250 S-D Automatic Overlapping End Cars are doing the work that previously required 293 of the same cars without Overlapping Ends. They eliminated every 6th car in a trip! How much tonnage are those 250 cars hauling? Four thousand tons per shift — 12,000 tons a day! (Maximum haul one way is six miles, minimum is three.) What happened to the tonnage carried by the other 43 cars? The S-D Overlapping Ends and their ability to assure MAXIMUM LOADING are now handling their loads! How much did the changeover save them? Approximately $250,000.00 annually! Due, in the main, to S-D Overlapping End Cars eliminating manpower at the loading stations.

Reason this direct comparison can be made is because this customer converted their conventional S-D Automatics by having us produce S-D Overlapping End "sections," which were installed on their cars at the mine. Only bottom dumping mine cars can have Overlapping Ends. You, too, can convert your present bottom dumping cars, height of car and curve radii permitting. If you are not using bottom dumping mine cars, you have the greatest opportunity in the history of mining to drastically reduce your haulage costs, an opportunity that deserves your immediate and serious consideration.

This Sanford-Day NON-STOP MAXIMUM HAULAGE system is in operation daily at several mines — some large, some small. To see any one of them will surely convince you. Would you like to know where they are? If not convenient to actually see one right away, call us and we will show you documentary filmed report or we will mail film to you so you can see and study at your convenience this NON-STOP MAXIMUM HAULAGE system in actual mine operations. You don't want to order another mine car, regardless of design, until you do. Write or call us today!

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MINE CARS — all types . . . S-D Brakeman Cars . . . S-D Man Cars . . . S-D Hydraulic Car Spotters and "Brownie" Hoists . . . S-D Automatic Loading Stations for mine and railroad cars . . . S-D "Floater" Wheels . . . S-D Mine Sheaves and Rollers . . . S-D exclusive Hard-Facing Process that puts old wheels back in operation for years of additional service.

As Viewed by HENRY I. DWORSHAK of the American Mining Congress

THE Congress of the United States completed its 171st year of business on September 15—unless the President calls a special session—and most of its members are now repairing political fences in their home States and districts. Before adjourning Congress adopted a resolution calling for the convening of the second regular session of the 86th Congress next January 6.

A grand total of 13,837 bills and resolutions was introduced during the session just ended—10,676 in the House and 3,161 in the Senate. Of these, more than a thousand were placed on the calendars of both Houses, but fewer than 350 became public laws (nearly 200 private bills were also passed). As the upcoming session is part of the 86th Congress, all measures will have the same legislative status they had at adjournment; those not acted upon this year are not necessarily "dead."

In the latter category, for instance, is legislation to establish a wilderness preservation system composed of large areas of national forests and other public domain lands for the virtually exclusive use of affluent outdoor enthusiasts (not necessarily sportsmen, for hunting would generally be barred). The Senate Interior Committee considered the so-called Wilderness Bill at three sessions in August, but announced later that further consideration would be postponed until next year.

CONGRESS APPROVES MINING RESOLUTION

In the closing days of the session, the Senate completed action on a resolution declaring that Congress believes it is in the national interest to foster and encourage a sound and stable mining and minerals industry.

Adopted earlier by the House, the resolution also requests the President to have reviews made at once of existing Government programs so as to use them more effectively to increase production of metals and minerals and increase employment in critically depressed domestic mining industries.

A resolution of this type does not require the President's signature and does not have the force of law. However, Rep. Aspinall (Dem., Colo.), chairman of the House Interior Committee and author of the resolution, expressed confidence that President Eisenhower would speedily initiate the requested reviews and studies. Aspinall suggested that any legislative proposals or reorganization plans which the President might submit as a follow-up should be timed to coincide with the reconvening of Congress next January 6.

The Senate also passed a bill by Senator Allott (Rep., Colo.) which would enunciate an over-all national minerals policy if it is passed by the House and signed by the President. This measure would require the Secretary of Interior to report annually to Congress on the state of the domestic mining and minerals industry, including a statement of the trend of utilization and depletion of mineral resources, together with such recommendations for legislative programs as may be necessary to implement the stated minerals policy.

PRESIDENT SIGNS LABOR BILL

President Eisenhower last month signed into law a rather comprehensive labor reform bill hammered out by Congress after months of public hearings and closed-door Committee sessions. The new statute, first major labor legislation since enactment of the Taft-Hartley Act in 1947, is becoming to be known as the Labor Reform Act of 1959.

Aimed at halting union racketeering and curtailing the economic power of organized labor with a view to preventing abuses, the reform measure puts new restrictions on organizational and recognition picketing and attempts to close loopholes in Taft-Hartley Act prohibitions against secondary boycotts. It also permits State courts or agencies to assume jurisdiction over labor disputes which the National Labor Relations Board has refused to handle on the basis that they are too small.

Other anti-racketeering provisions of the new law, stemming from the

Washington Highlights

MINERALS POLICY: Congress approves resolution

LABOR REFORM: President signs bill

COAL RESEARCH: Bill vetoed

FUELS POLICY: Measure wins Committee approval

URANIUM: Statistics are revealed

ENERGY RESOURCES: Hearing scheduled

COAL MINE SAFETY: Small mines bill moves

BARTER: Program again revised

FLUORSPAR: Imports deemed not excessive

GOVERNMENT STATISTICS: House Committee Investigating

McClellan "Rackets" Committee's lengthy investigation of union misdeeds, require a variety of financial reports by union officials and, to a lesser extent, by management; spell out a "bill of rights" for union members; regulate democratic procedures within unions; and place other restrictions on the power of union officers, including use of international trusteeships over local unions.

Labor Secretary Mitchell later announced the establishment of a Bureau of Labor-Management Reports to process financial and other reports required from unions and management by the reform measure.

COAL RESEARCH BILL VETOED

President Eisenhower has vetoed a bill which would have set up an independent Coal Research and Development Commission to supplement the work of the U. S. Bureau of Mines. His action, although not entirely unexpected, was a blow to the bituminous coal industry, which had long supported this legislation.

The President based his veto on the grounds that Government functions should be grouped on the basis of purpose, and that creation of a new agency would result in "dilution" of Interior Department authority over coal. He commented that the bill was undesirable also because it could serve as a precedent for the creation of other special agencies.

One provision of the vetoed measure, however, was characterized by the President as "highly desirable." This provision would have authorized the Commission to contract for outside research on methods to improve mining and increase coal markets.

As a result of the veto, Congress is expected next year to consider somewhat similar legislation which would increase the authority of the Secretary of Interior to provide additional coal research—including use of nongovernment contractors—under the direction of the Bureau of Mines.

COMMITTEE APPROVES FUELS POLICY PROPOSAL

The Senate Interior Committee has approved a resolution which would establish a temporary joint committee of eight Senators and eight Representatives charged with the formulation of proposals for a national fuels policy. Before the Senate can act on it next year, however, the resolution must also be approved by the Rules and Administration Committee.

Almost simultaneously, the House Rules Committee tabled until next year an identical resolution. Under House rules, a bill calling for the creation of a new committee must go directly to the Rules Committee rather than to the Committee which ordinarily would have jurisdiction over the subject matter involved.

To become effective, either resolution must be adopted by both Houses of Congress.

AEC REVEALS URANIUM STATISTICS

Heretofore secret statistics on Government uranium concentrate procurement from domestic and foreign sources during the fiscal years 1948–1955, just revealed by the Atomic Energy Commission, emphasize the phenomenal growth in little more than a decade of domestic production of uranium concentrate (figures for the four most recent fiscal years were announced in a series of statements dating back to December 1956).

In fiscal year 1948, according to the AEC's latest statement, the domestic uranium industry delivered only 110 tons of uranium oxide in concentrate to the AEC; during the same year the Commission procured 1,960 tons from foreign sources. During the 1959 fiscal year, which ended June 30, domestic procurement amounted to 15,160 tons, compared with 18,170 tons from foreign sources. The Commission commented that procurement from domestic sources is "now expected to equal or exceed foreign receipts in fiscal years 1960 and 1961."

An AEC spokesman announced earlier this year that, as the result of expiring contracts, procurement of uranium oxide from foreign sources would decline from a high of approximately 18,600 tons in the current fiscal year to only 870 tons in 1967, in which year domestic procurement will have declined only slightly to an estimated 16,200 tons.

ENERGY RESOURCE HEARINGS SLATED

A week of public hearings, part of a broad study of the Nation's energy resources and technology, were scheduled to begin October 12 in Washington, D. C., by the Joint Congressional Subcommittee on Automation and Energy Resources. When he announced the hearings, Subcommittee Chairman Rep. Patman (Dem., Tex.) said that "special attention will be given to the over-all prospective requirements and demand for energy from the conventional sources and to the outlook for commercial production from other sources such as nuclear and solar power."

Patman also said the coal industry witnesses, scheduled to testify October 15, include George A. Lamb, Consolidation Coal Co., and Joseph E. Moody, president, National Coal Policy Conference.

COMMITTEE APPROVES COAL MINE SAFETY BILL

Just before adjournment, the Senate Labor Committee approved a bill which would amend the Federal Coal Mine Safety Act to extend its inspection and enforcement provisions to coal mines regularly employing less than 15 persons. The measure is now on the Senate calendar and may be taken up after Congress reconvenes in January.

The bill would permit the Director of the Bureau of Mines to make exceptions in the case of small mines where the Act's provisions would not substantially contribute to the safety of men working in such mines.

BARTER PROGRAM RE-REVISED

Once again the Agriculture Department has revised its regulations governing the barter of surplus Government-owned agricultural commodities for foreign-origin strategic minerals and materials—with the result that the volume of these transactions may decline.

The new rules removed eight nations from the list of those eligible to trade minerals for specified surplus commodities such as cotton and wheat. These countries, which have been determined to be fully able to pay for U. S. farm products in dollars or other currencies readily convertible into dollars, are Canada, Belgium, Luxembourg, The Netherlands, Switzerland, Great Britain, West Germany, and Japan.

Department officials said the change "could result in a reduction" in new barter contracts to be signed during the current fiscal year. In the fiscal year ending last June 30, the Department approved barter contracts involving $158.1 million of farm surplus.

FLUORSPAR IMPORTS DEEMED NOT EXCESSIVE

Imports of fluorspar are not threatening to impair the national security, Civil and Defense Mobilization Director Leo A. Hoegh announced recently after conclusion of an 11-month study in the field of fluorspar supply and requirements.

Hoegh's decision was made in response to a petition filed with the Office of Civil and Defense Mobilization on October 29, 1958, by the American Fluorspar Producers Asso-

ciation. Filed under the National Security Amendment to the Trade Agreements Act, the petition alleged that imported fluorspar had captured a major portion of the domestic market and that such imports, unless limited, would seriously affect the domestic industry and impair the national security.

Before reaching a decision, Hoegh said, he had obtained the advice of Government agencies having responsibility and experience in the field of fluorspar supply and requirements. He concluded that increased domestic production of fluorspar is not necessary for defense, that there is no defense need for further stockpile acquisition, and that the petitioners' proposal for quantitative restrictions on imports of fluorspar "is contrary to the foreign economic policy of multilateral trade advocated by the United States."

GOVERNMENT STATISTICS UNDER STUDY

Government statistical reports are being investigated by a House Government Operations subcommittee. Chairman Lesinski (Dem., Mich.) has recently announced that he will look into possible reductions in governmental reporting requirements in a series of field hearings beginning in San Francisco in late October. He hopes to obtain from labor and industry officials recommendations and information as to Government reporting requirements which place an undue burden on business and which are disproportionate to the need and use for the information collected. He is also seeking information as to duplications in reports required of industry by the Government, as to those reports which have outlived their usefulness, and as to those reports which should be modified to conform to industrial practices or which should be eliminated entirely.

The subcommittee expects to look into recent proposals of Government agencies to institute an annual survey of the mineral industries, which has been opposed by representatives of the extractive industries as being overly burdensome and as duplicating commodity reports now being submitted to the U. S. Bureau of Mines.

OIL IMPORTS UNCHANGED

Mandatory restrictions on imports of residual oil will be continued without change as a result of a recent Administration decision. Twelve New England Senators had urged the President to relax these restrictions stating that they would lead to acute shortages during the coming winter. The President, however, told the group that there will be "adequate" residual oil in the New England area this winter and that the mandatory import restriction program has not shown signs of causing increased costs. Similar information had previously been given Congressmen from the New England area by Commerce Secretary Frederick Mueller.

Meanwhile, a Federal District Court in Texas has ruled that the mandatory oil import program is constitutional.

COBALT PETITION REJECTED

The Government has turned down a plea by domestic cobalt producers for imposition of quotas as a means of maintaining U. S. production of the mineral. OCDM Director Leo Hoegh, acting under Section 8 of the Trade Agreements Act, declared that imports of cobalt are not threatening to impair the national security as domestic producers had contended. He also stated that the United States is in favorable position to meet emergency requirements for cobalt and that Government stockpiles of the metal are already larger than the goals require.

personals

Phillip T. Maddex has been appointed chief engineer for the United States Borax & Chemical Corp. He will have the responsibility of directing corporate engineering activities and will work out of company headquarters in Los Angeles.

Maddex formerly served in various engineering capacities with General Electric Co.; Battelle Memorial Institute; National Lead Co. His most recent position was that of manager of the Henderson, Nevada plant of the Titanium Metals Corp.

Dr. Siegfried Muessig, has been appointed chief geologist, United States Borax & Chemical Corp. Dr. Muessig served for eight years with the mineral deposits branch of the U. S. Geological Survey before joining U. S. Borax.

American Zinc, Lead & Smelting Co. recently announced two personnel changes.

J. W. Burgess was promoted to chief engineer for the parent and all operating subsidiary companies. He has been manager of construction for Uranium Reduction Co. at Moab, Utah, since 1955.

William M. Calhoun was made assistant to the resident manager of the Metaline Falls, Wash., operations. In addition to his supervisory duties, he will continue to direct all local geological activities.

B. W. Bernstrom, chief engineer of the Electrical-Mechanical Department of Pickands Mather & Co., recently resigned his position to join Kaiser Engineers.

Warren H. Westphal, former chief geophysicist for Utah Construction Co., has joined the staff of Stanford Research Institute as senior geophysicist.

Prior to joining the Institute, Westphal directed the geophysical program of the Utah Construction and Mining Co., and participated in numerous mineral exploration activities. Earlier he held positions with Tidewater Associated Oil Co. and New Jersey Zinc Co.

Jack H. Morrow, formerly operating engineer, has been appointed assistant superintendent of the Mine Operation Department of the M. A. Hanna Company's iron mines in Iron River, Mich.

Walter H. Taschek has been appointed superintendent of the Henderson, Nev., lime plant of United States Lime Products Division of the Flintkote Co.

Evan Hall has been named technical assistant to plant manager for Calaveras Cement Co. Hall will also continue as mill superintendent, a position he has had for a number of years.

William L. Hearne has been appointed vice president—taxes for United States Steel Corp. Hearne has served as director of the Tax Division since 1941 and has long been active in tax work of the American Mining Congress.

Miles P. Romney has been named chairman of the Emergency Lead-Zinc Committee succeeding **Charles E. Schwab,** who is to become general manager of Kellogg, Idaho operations of Bunker Hill Co. Since 1952, Romney has been manager of the Utah Mining Association and will continue in that position. He had previously been general manager of Duvall Co. and for many years prior had been associated with U. S. Smelting, Refining & Mining Co. as a geologist and field engineer.

M. P. Romney

Richard E. Miller, assistant plant manager, Northampton, Pa. plant, Universal Atlas Cement Div., United States Steel Corp., has been named to succeed **Raymond W. Smith,** plant manager, who is retiring after 38 years service with the company. **Roger Melgary,** plant industrial engineer will succeed Miller as assistant plant manager.

1960 AMC Coal Convention

With the appointment of Robert H. Hughes, president, Clinchfield Coal Co., as chairman of the Program Committee for the 1960 Coal Convention of the American Mining Congress, plans are moving ahead under "full steam" for the industry's outstanding event of the year. The meeting will be held in Pittsburgh next May 9–11.

Robert H. Hughes

"Bob" Hughes, who has been associated with the coal industry for nearly 25 years, will head a nation-wide committee of coal mine operators and equipment manufacturers in the important task of selecting subjects and speakers for the 1960 meeting. This group has the responsibility of developing a comprehensive, well-rounded program that will deal with the industry's important problems and will spell out the latest advances in methods and equipment for mining and processing coal—with emphasis on improving operating efficiency and cutting costs.

Anyone wishing to suggest topics for discussion and prospective speakers should write to the American Mining Congress, Ring Building, Washington 6, D. C. The Program Committee will meet early in November to consider all of the suggestions received and to draw up a program having the widest possible appeal to the industry.

Charles B. Hausen has been named to fill a newly created position of corrosion engineer, Bunker Hill Co. Formerly assistant smelter superintendent Hausen originally joined Bunker Hill in 1932. **Donald F. Ingvoldstad,** who succeeds Hausen as assistant smelter superintendent, had been chief research metallurgist for the smelter since 1954.

D. Ingvoldstad

C. Hausen

Harry Bradbury, presently president of Glen Alden Coal Co., will also assume the presidency of Blue Coal Corp. succeeding **Charles Spencer** who has resigned. Spencer has been associated with the company 25 years.

Earnest E. Thurlow has been appointed chief geologist for the Northern Pacific Railway. He succeeds **Donald W. Lindgren** who has resigned to enter a new firm, Lindgren & Lehmann, consulting mining geologists.

Norman Yarbrough, assistant general superintendent of United States Steel Corp. coal mining operations at Lynch, Ky., has resigned to join Harlan Fuel Co., Yancey, Ky.

Robert N. Morris has been appointed general manager of the newly formed Southern Division, North American Coal Corp. Morris joined North American Coal in 1955, as assistant to the vice president-production. **Robert A. Maurer,** formerly general manager of The Red Parrot Coal Co., has been promoted to manager of mines of the Southern Division.

A. Harold Truax recently retired as chairman of the board of the Truax-Traer Coal Co.

Robert G. Axtell has been appointed to the newly created post of director of marketing, Glen Alden Corp.

Herrick W. Gould, assistant to the director of purchases, Colorado Fuel and Iron Corp., has retired. Gould, now 73, had been with the company 41 years.

William P. Nicholls has been elected president of White Pine Copper Co. Nicholls has been with the company for 24 years and has served as a vice president since 1952. In 1957 he was also appointed general manager of White Pine.

Clark L. Wilson, vice president, New Park Mining Co., has been elected chairman of the Western Governors Minerals Advisory Council, succeeding **S. H. Williston,** vice president, Cordero Mining Co.

W. G. Maloney, consultant for the Mining Association of Montana, was named vice chairman. Secretary is **Frank A. Knight** of the Arizona Department of Resources.

Glenn C. Waterman has been promoted to chief geologist for Anaconda Co. of Canada, Ltd. Since 1955 he has been exploration geologist in the Salt Lake office of Anaconda exploration.

Dr. Edward L. Clark has resigned as vice president, Four Corners Oil & Minerals Co., to become Colorado's first director of natural resources.

Lloyd E. Antonides has been appointed mining engineer for Associated Metals & Minerals Corp.

Dean R. Gidney has resigned from United States Borax & Chemical Corp. He had served as vice president and general manager of the United States Potash Co. division of the company since 1956. **J. F. Corkill,** who was vice president and general manager of the Pacific Coast Borax division has been appointed to direct activities of the department combining functions of the two divisions.

John M. Haivala has become general superintendent of mines, Chino Mines Division, Kennecott Copper Corp., succeeding **G. J. Ballmer** who retired earlier this year. Haivala previously had been assigned to special projects for Cleveland Cliffs Iron Co.

Cris Dobbins, president, Ideal Cement Co., has been reappointed to the manufacture committee of the Chamber of Commerce of the United States.

Bengt R. F. Killgren, president of Brush Beryllium Co., has become a director of Beryllium Resources, Inc.

E. C. Stephens, has been named to the advisory board of Washington State University's Institute of Technology. Stevens is head of the Northwest regional exploration office of the Anaconda Co.

OBITUARIES

Fred S. McConnell, 82, widely recognized as one of the deans of the coal industry, died August 16 at his home in Cleveland, Ohio.

Mr. McConnell entered the coal business in 1910 with the Eastern Kentucky Coal Co. and in 1917 he became associated with the Enos Coal Mining Co. He became president of Enos in 1940. For some time before his retirement in 1956, Mr. McConnell was also chairman of the board of Enoco Collieries, Inc. and was vice president of the Algers, Winslow & Western Railroad.

Kellogg Krebs, president, Equipment Engineers Inc., died August 25.

Since 1950, Mr. Krebs had also worked as a consulting metallurgist and previously had been associated with American Cyanamid Co. for 22 years.

Sergei E. Zelenkov, 45, assistant manager, Northwestern Mining Department, American Smelting & Refining Co., died August 16 of a heart attack in Wallace, Idaho. Mr. Zelenkov had been associated with the company since 1936 following graduation from Colorado School of Mines.

Jack Dalton, 89, president, Mountain States Coal Corp., died September 22 at Pikeville, Ky. Mr. Dalton had founded Mountain States in 1941.

Edgar C. Weichel, 74, died at Concord, N. C. August 14 after a long illness. Mr. Weichel had been associated with the Hudson Coal Co., Scranton, Pa., for 32 years before his retirement in 1955. He had been a vice president of the firm 1950 to 1955 and had served the mining industry since 1903.

Walter F. Mumford, 59, president of United States Steel Corp., died at Cape Cod Hospital September 28. Mr. Mumford had been president and chief administrative officer of U. S. Steel, a member of its board of directors and chairman of its executive committee since May 5. He had been with the firm since 1923.

NEWS and views

Eastern Gas Completes "Test Kitchen"

An expansion of facilities to create one of the world's finest specialized laboratories, a "test kitchen" for bituminous coals, has been completed at Everett, Mass., by Eastern Gas & Fuel Associates. This expansion nearly doubled the size of the lab and added new equipment.

Assignment of this laboratory is to develop better or more economical coke. Researchers can study the behavior of coals in quantities from one ounce to 500 lb and then, because Eastern also operates its own coal mines, coke plants, and a blast furnace, they can test their findings in plant-scale operations.

Showpiece of the expanded laboratory is a new, specially-designed pilot-scale coke research oven with a movable sidewall. This oven has a capacity of about 500 lb of coal as against 18 tons for a commercial coke oven. It is electrically heated and its inside temperature can be controlled to within a few degrees in the range from 1000° to 2000°F. Instruments connected with the movable sidewall are so sensitive that they will record an increase in pressure so slight as to move the wall only 0.001 in. In this oven researchers can study both the important factor of expansion and also the changes in quality resulting from variations in the coking procedure.

American-Marietta Plans to Buy Cement Company

A plan whereby American-Marietta Co., Chicago, would acquire Dewey Portland Cement Co., Kansas City, Mo., has been announced by the two companies. The proposal has been approved by directors of both companies and is being submitted to Dewey shareholders for approval.

Since 1954 American-Marietta has been expanding its cement plants serving the Atlantic Seaboard and the Southeastern States. Dewey, a 53-year old company with kilns and quarries at Davenport, Iowa, and Dewey, Okla., is a major producer of portland cement in its trade area. A third Dewey plant is under construction near Tulsa, Okla.

Central West in West Virginia

Central West Coal Co. has announced plans for operating a new mine in the Blackwater coal field of northern West Virginia. This field represents one of the largest blocks of virgin commercial coal left in the country it is said.

Central West is opening up a strip mine and it also has a 2000 tons per day deep mine under development. A 250 tph washing plant was recently completed and it is expected that the planned initial production rate of 4000 tpd will be reached soon.

Metal & Thermit Establishes New Division

The formation of a separate Metals & Minerals Division, with James L. Oberg as general manager, has been announced by Metal & Thermit Corp. This new division will have responsibilities for research, production, sales and technical service for M & T metals and minerals, including ferro titanium, nickel titanium, chromium, rutile and ilmenite. It will operate a mine at Hanover, Va., and mineral milling operations at Carteret, N. J.

West Virginia Man Presented Mine Award for Courage

Thomas Allamon, Federal inspector for the U. S. Bureau of Mines, was recently presented a valor award for displaying exceptional courage involving great personal risk to rescue four men who were injured in a gas explosion in the Burton mine of Oglebay-Norton Co. at Craigsville, W. Va., on October 28, 1958. The presentation from the Joseph A. Holmes Safety Association was made by Allamon's supervisor, W. R. Park, district supervisor of Health and Safety, District C. Previously, Willard S. Hamrick, a foreman employed at the Crichton No. 4 mine of Johnstown Coal & Coke Co., received a similar award for collaborating with Allamon in the rescue of the four men.

TVA's Foreign Buying is Up

The Tennessee Valley Authority spent three times as much money on foreign-made equipment during the year ending June 30 as during all the years since TVA's inception in 1933. The agency reported purchases totaling $125,936,788 during the fiscal year for materials, equipment, supplies and nonpersonal services. Of this, $66,924,517 was for manufactured goods such as turbines, generators and transmission lines. A total of 27 percent of the money for manufactured equipment went to foreign firms.

Coal Excavation Planned to Halt Mine Fire

A $3,000,000 three-year project is scheduled to eliminate an underground mine fire which threatens to spread under the Carbondale, Pa., business district. The underground fire broke out in 1946 when rubbish was dumped into abandoned coal strip pits. Officials over the years have tried to extinguish the fire by drilling holes into the earth and pumping silt bearing water into them. Under

(Continued on next page)

(Continued from previous page)

the new plan, power shovels will dig trenches to surround and seal off the fire; then the burning coal will be taken out, dumped on high ground and sprayed with water. The Federal Government plans to spend $2,000,000 and the State another million to extinguish the fire.

Pennsylvania Mine to Get New Cleaning Plant

A new coal preparation plant is being constructed for the Heshbon Mine near Johnstown and Windber, Pa.

The mine, which is operated by the Pennsylvania Coal & Coke Division of Fairbanks Whitney Corp., has a capacity of 1500 to 2000 tons of coal daily.

The contract to design and construct the cleaning plant was awarded to Roberts & Schaefer Co. Start of construction is scheduled soon and the coal company hopes to have it in operation by November 1.

ALSO . . .

A metallurgical research center which will contain equipment to fabricate and heat treat such refractory metals as columbium, tantalum, titanium, zirconium, tungsten, and chromium will be constructed at E. I. duPont Company's Baltimore, Md., plant. The installation will be completed by the fall of 1960 and will employ personnel with specific experiences and skills in metallurgy.

Bituminous Coal Research, Inc., has received a contract from the Atomic Energy Commission to study possible uses of radioisotopes in the coal industry. To be completed early next year, the study will note where use of isotopes could bring more efficiency in the mining, preparation, transportation, storage, handling and use of coal and will suggest areas for research and the development of new techniques.

Michigan Chemical Corp. has announced the start-up of its new magnesium oxide plant at Port St. Joe, Fla. Augmenting extensively its Michigan magnesia operation which will continue to produce caustic magnesia and specialties, the new plant will provide industry with high-purity chemical and refractory grades of magnesium oxide.

The Kirk Coal Mining Co. near Central City, Ky., recently closed after 15 years of operation. The reason given is that general conditions in the coal mining business made its operations no longer profitable. The mine employed 140 men and at full capacity produced 2200 tons of coal in two eight-hour shifts.

Lithium Corp. of America will move its entire laboratory and manufacturing operations to Bessemer City, N. C., from Minnesota this fall. Executive offices will be transferred from Minneapolis to New York City. With the consolidation, the Bessemer City plant will be the only one in the United States carrying lithium all the way from ore to finished product.

Hi Hat Elkhorn Coal Co., Hi Hat, Floyd County, Ky., has been bought by a group headed by John R. Fields, formerly vice president and treasurer of Guyan Eagle Coal Co.

Pennsylvania Glass Sand Corp. has reported the purchase of Floridin Co. of Tallahassee, Fla. The Florida company mines and processes fuller's earth.

The Kentucky Department of Conservation recently announced that 9346 acres have been reclaimed in the State since the strip mining and reclamation act was inaugurated in 1954. The program is financed by mining operators.

Hanna Coal Co. has closed its underground mine at Piney Fork, Ohio, until the demand for coal increases.

Nova Scotia mines department geologists have reported finding numerous occurrences of beryllium along the Province's south shore.

Coal supplied 68 percent of the fuel used by steam-electric generating plants in the United States during 1958, according to the National Coal Association's yearly summary.

American Smelting & Refining Co. has begun production of high purity gold at its central research laboratories at Plainfield, N. J. The high purity metal is being produced for research purposes and to meet special requirements of the electronics industry.

The Maine Mining Bureau has announced the signing of its first long-term mining lease. The lease, negotiated with the Roland F. Beers Co., of Troy, N. Y., includes about 150 acres of State-owned land. Beers plans to continue an exploration program to outline a nickel-copper prospect.

One of the world's largest basic oxygen steelmaking furnaces, to be constructed at the Cleveland Works of Jones & Laughlin Steel Corp., ultimately will produce 200-ton heats. The furnaces and related equipment are expected to cost $24,000,000.

An expansion program is underway at Foote Mineral Company's electromanganese plant at Knoxville, Tenn. It will be a general expansion, plus a new laboratory building, and will increase production somewhat. The expansion is scheduled to be completed by the end of 1959.

Cerro de Pasco Corp. has liquidated its U. S. fabricating subsidiary, Rockbestos Products Corp., New Haven, Conn., and operations of Rockbestos now will be conducted as the Rockbestos Wire & Cable Co. Division of Cerro de Pasco Corp. Changed status and identity of the Rockbestos company is part of a corporate simplification plan to bring about various operating economies.

The Lead Industries Association has initiated an extensive research project to develop engineering data on the use of lead in the control of vibration in buildings and machinery.

Iron-ore output in the United States in 1958 was the lowest reported in 20 years, according to the U. S. Bureau of Mines. For the first time in history imports comprised more than one-fourth of the total quantity of iron ore available to domestic consumers.

The possibility of the development of a large limestone mining operation in the Carntown area of Pendleton County, Ohio, has been announced by the Marble Cliff Quarries of Columbus, Ohio. Test cores drilled by the company indicate desirable deposits of "flux stone" for use in steel production are to be found at a depth of 400 ft. Additional tests will be made to determine if such a deep mining operation is economical.

(More next page)

The first of hundreds of mineral specimens that are eventually to be displayed by the American Society for Metals in an imaginative open-air mineral garden are beginning to arrive at Society headquarters. The garden, which will be 100 ft in diam, and saucer-shaped, is to be the central feature in the huge piazza of the new ASM office headquarters building now nearing completion 23 miles east of downtown Cleveland. With a two-fold purpose of being decorative as well as educational, the garden will contain upwards of 350 ore specimens when completed. Each sample is to be fully described and the donor identified. Largest specimen received to date is an 8000-lb sample of jasper from the Cleveland Cliffs Iron Co.

Long-range appraisal of mechanized mining will be among the themes discussed by leading authorities at the Joint Solid Fuels Conference to be held October 27–29, in the Netherland-Hilton Hotel, Cincinnati. Sponsors will be the Coal Division of the Society of Mining Engineers of AIME and the Fuels Division of The American Society of Mechanical Engineers.

An ore roasting and sulphuric acid plant for Sherbrooke Metallurgical Co., Ltd., subsidiary of Matthiessen & Hegler Zinc Co. of LaSalle, Ill., is being constructed at Port Maitland, Ontario. The ore roasting plant will utilize Canadian zinc ores, and a contact sulphuric acid plant will utilize both the gases from the ore roasting plant and from burning of elemental sulphur. Completion is scheduled for July next year.

Southwestern Pennsylvania Safety Association held its first aid contest in Waynesburg, Pa., August 15. A team from the Nemacolin Mine of Buckeye Coal Co. took first place, followed by the Hutchinson Mine, Pittsburgh Coal Co., and Marianna Mine No. 58, Bethlehem Mines Corp. Winning teams received cash prizes and trophies.

Bucyrus-Erie Co. has acquired the plans and patents for the Kolbe Wheel Excavator. The company now has work under way on a wheel for the Peabody Coal Co. for use at its River King mine near Freeburg, Ill. This wheel will incorporate features covered by the Kolbe patents.

The U. S. Bureau of Mines has announced that improved methods for producing superior metals, alloys and compounds needed in nuclear-energy, astronautics, electronics and other important fields will be sought in an accelerated columbium-tantalum research program during the 1960 fiscal year. New projects will emphasize low-grade domestic raw materials as sources of the two metals. The Bureau also announced the beginning of an extensive new research program for tellurium. The program will include a widespread search for new domestic sources of this element.

Peabody Coal Co. has purchased a 65-cu yd shovel from Marion Power Shovel Co. for use at its Lynneville mine near Evansville, Ind. The machine's 170-ft boom is said to be the largest shovel boom ever made. The machine is scheduled to be in full operation before the end of the year.

Annual Coal Division Conference

Penn-Sheraton Hotel, Pittsburgh, Pa., Thursday, November 5, 1959

THE 1959 Annual Conference of the American Mining Congress Coal Division will be held at the Penn-Sheraton Hotel in Pittsburgh, November 5. The one-day meeting will convene at 9:30 A.M.

To all those who mine and prepare the Nation's coal and to the manufacturers who supply the necessary tools and equipment, is extended a cordial invitation to attend the Conference. Each of the Coal Division Committees will recount the results of studies carried on during the past year. As in the past, reports will be open to discussion from the floor so that all may have an opportunity to offer comments or suggestions.

Studies to be covered are listed below:

Committee on Underground Power—James A. Erskine, Eastern Gas and Fuel Associates, Chairman—Recommended standards for AC Systems and Equipment in Coal Mines . . . Temporary Cable Splices . . . Cable and Cable Accessories for Mining

Committee on Underground Haulage—A. G. Gossard, Snow Hill Coal Corp., Chairman—Factors in the Consideration of Conveyor Selection . . . Turnout and Curve Data

Committee on Strip Mining—Edwin R. Phelps, Pittsburg & Midway Coal Mining Co., Chairman—Safe Practices for Handling Ammonium Nitrate

Committee on Roof Action—J. Allan Brookes, Mather Collieries, Chairman—Standardized Roof Bolt Testing Procedures . . . Roof Bolt Reclamation

Committee on Mechanical Mining—J. A. Younkins, Duquesne Light Co., Chairman—Face Ventilation for Continuous Mining . . . Pillar Extraction . . . Cost Control . . . Personnel Management

Committee on Mine Safety—Ralph E. Kirk, Birmingham, Ala., Chairman—Safety Aspects of AC Power

Committee on Coal Preparation—J. J. Reilley, Jones & Laughlin Steel Corp., Chairman—Preparation Plant Startup Problems . . . Cyclones vs. Drag Tanks . . . Coal Preparation Equipment Efficiency.

Tennessee is now the Nation's No. 1 zinc producer, according to a recently issued U. S. Bureau of Mines report. New York, the leading producer in 1957, fell to second place. Third largest producer was Idaho.

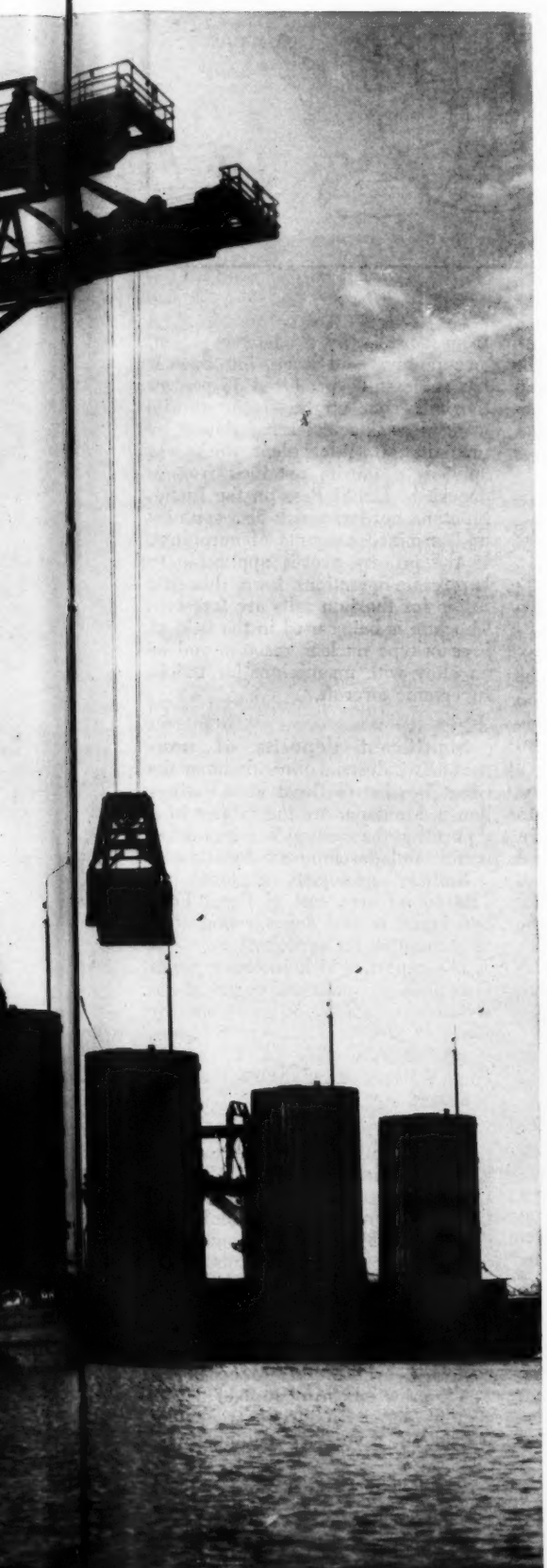
Oyster shells will be processed to produce high purity quicklime and hydrated lime products at facilities to be built by U. S. Gypsum Co. at New Orleans.

The 17th annual Pennsylvania State Bituminous First Aid Contest was won by a team of miners from Harmar Mine, Harmar Coal Co. Spectators saw them beat 27 other teams for the $350 first prize.

A bituminous coal binder was used paving material recently laid on nearly a mile of test highway in Kentucky. Curtiss-Wright Corp. officials believe the test strip will require less maintenance than materials now used—that its surface is less slippery—and the strip is not subject to damage from extreme changes in temperature.

World's largest coal unloading tower... rigged with

USS Tiger Brand—America's No. 1 Wire Rope



The world's largest coal unloading tower, dubbed the "Siamese Twins," was designed and built by the Dravo Corporation, Pittsburgh. It scoops up coal from barges at the rate of 2,600 tons an hour to feed the new Thos. H. Allen Electric Generating Station at Memphis, Tennessee.

The new unloader consists of two towers on a single base. Each of the two unloading units operates a 13.3-ton capacity bucket rigged with USS Tiger Brand Wire Rope. Tiger Brand was selected for its ability to stand up under continuous operation. It has the strength, flexibility and wear resistance necessary for this rugged job.

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1. It is made by a company that maintains the most complete research and manufacturing facilities in the steel industry.
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◀ Two 1500-ton coal barges can be unloaded in 100 minutes using Tiger Brand Wire Rope to do the lifting.

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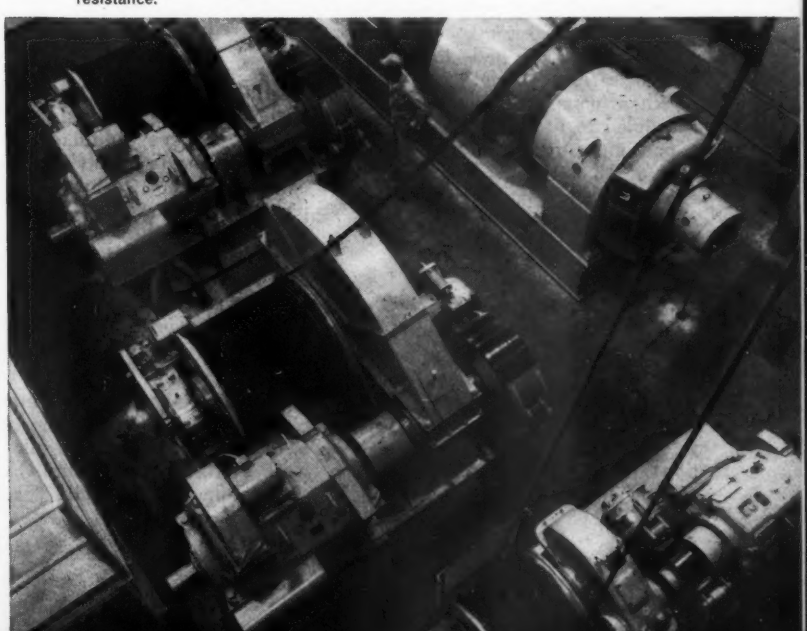


NEWS and views

Hawaiian Cement Expansion

Plans for the erection of a $12,000,000 cement plant in Hawaii are going forward. Participants in the venture include American Cement Corp. of Los Angeles and Cyprus Mines Corp., Los Angeles, each of which are reported to have a 40-percent interest in the new Hawaiian firm.

To meet the expected demand for cement, the Hawaiian Cement Corp. officials plan a facility which will produce more than 1,000,000 bbl of cement annually. Provisions will be made for a growing market in future years.

ASARCO Plans Arizona Development

American Smelting & Refining Co. will spend $43,500,000 over the next three years in developing an open-pit copper mine and milling operation at its Mission property near Tucson, Ariz.

Development follows extensive exploratory work begun in 1954 which consisted in part of 346 holes drilled to determine extent and grade of deposits. ASARCO sunk 2200 ft of shafts into the ore body to check results of earlier drilling.

When completed, the project is scheduled to produce 45,000 tons of copper annually from a daily production of 15,000 tons. The company's holdings cover approximately 250 acres which adjoin properties of Pima Mining Co. and Banner Mining Co.

ALSO . . .

Minimizing stream and groundwater pollution from radioactive uranium mill wastes will be the object of U. S. Bureau of Mines research during 1960. The Bureau hopes to develop improvements in milling operations by (1) trying to reduce the amount of solution discarded through prolonging solution recycling, (2) attempting to develop processes for recovering uranium from clear solutions and leach slurries, and (3) investigating new leaching techniques and simplified recovery procedures for fringe-area deposits.

A new uranium mill 75 miles west of Casper, Wyo., will be in production by January 1960, according to Globe Mining Co. officials. Strip mining operations will take place near the mill site as well as on Globe's mining properties 12 miles away. General administration for Globe will be integrated with other Union Carbide mills through Union Carbide Nuclear Co. offices in Grand Junction.

A million dollars worth of new mining equipment will be put into operation during the next year at International Minerals & Chemical Corporation's operation at Carlsbad, N. M. The new equipment is being installed to serve the double purpose of helping the company keep pace with current demand for potash products and prepare for long-term continued operation of the mine.

Shaft sinking in the Coeur d'Alenes will reach record depths for the district upon fulfillment of Sunshine Mining Company's plans. The company intends to sink a three-compartment off-set winze 420 ft to bottom at 1720 ft below sea level. New working levels will be established at the 4150 and 4300 ft levels after which about 1650 ft of cross-cutting is planned. The project will require about two years to finish.

Production of high-grade thorium concentrates from thorite may be possible as a result of pilot plant work by Sawyer Petroleum Co.

Thorium is generally extracted from monazite by a relatively expensive boiling acid leach, but Sawyer has successfully produced 35 percent thorium concentrates from thorite using a weak-acid leach followed by precipitation. Pilot plant work was applied to thorite obtained from a deposit at Lemhi Pass on the Idaho-Montana border, which also contains undetermined amounts of europium. If the process proves applicable to large-scale operations, lower domestic prices for thorium salts are foreseen. Thorium is being used in the field of breeder-type nuclear reactors and as an alloy with magnesium for use in supersonic aircraft.

Significant deposits of nonmetallic industrial minerals along the Great Northern's Great Falls-Billings line in Montana, are the subject of a report by the railway's mineral research and development department.

Railway geologists explored an 1100-sq mi area east of Great Falls and found several deposits that offer opportunities for exploitation.

The report, which includes geologists findings, maps and chemical analysis of deposits, is available for study at Montana Bureau of Mines, Butte and from offices of the railway mineral research and development department.

First production shipment of 250 tons of ore containing 0.22 percent U_3O_8 was recently made from Lance Corp., Section 12 mine, in McKinley County, N. Mex. to the Homestake-Sapin Partners mill at Grants. Company estimates indicate the mine can produce at a maximum rate of 1000 tpd by December of this year. Approximately 600,000 tons of 0.30 percent U_3O_8 ore have been blocked out at the mine which is owned 75 percent by Sabre-Pinion Corp. and 25 percent by Homestake Mining Co.

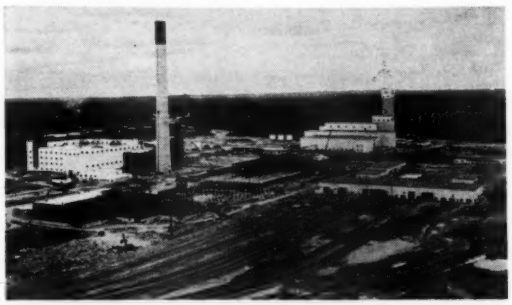
Dynamic Metals Corp. is the name of a joint venture for mining and milling beryllium formed by Radorock Resources, Federal Uranium Corp., Lison Uranium Corp., and Hidden Splendor Mining Co.

The new company has exclusive rights to a reagent which seemingly has the specific ability to float beryl free and clear of other material. The new flotation process could replace previously used methods of separation and make feasible the development of new beryllium reserves in this country.

The same group of companies has created a second company, Beryllium Resources, Inc. to acquire beryllium ore properties, conduct exploration, development and mine activities. In this connection, Mt. Wheeler Mines has announced a $1,900,000 sale to Beryllium of 111 patented and unpatented claims in the Mt. Washington district, White Pine Co., Nev.

A $2,000,000 phosphoric acid plant is to be built by Bunker Hill Co. at Kellogg, Idaho, home of the company's mining and major metallurgical operations.

The plant is slated to initially produce 130 tpd phosphoric acid using by-product sulphuric acid from Bunker Hill's electrolytic zinc plant nearby. Acid plant construction represents the first stage of long-term plans calling for multi-million dollar facilities to manufacture fertilizers.



Second largest nickel-producing operation in the world, that represents an initial expenditure of $175,000,000, is scheduled for start-up in 1960. International Nickel Co. of Canada's fully integrated nickel plant at Thompson, Manitoba is expected to be in full production in 1961 at an annual rate of 75,000,000 lb of nickel.

Since announcing the project late in 1956, INCO has sunk a 1057-ft development shaft, a 2100-ft production shaft and has completed over 12 miles of development work. All mining, concentrating, smelting and refining facilities are being completed in addition to a townsite with accommodations for an initial population of up to 8000.

The project represents the largest single investment in Manitoba and will be the free world's first fully integrated nickel plant all in one location.

A 3200-ft shaft will be sunk at Asarco-controlled Mt. Isa Mines Ltd. in Queensland, Australia. The several million dollar project will take at least five years to complete. The shaft will be concrete lined, with a 24-ft internal diameter and provided with equipment that will bring its hoisting capacity to 800 tons of ore per hour from a depth of 3000 ft. Plans provide for two-cage hoists, the larger of which will handle 160 men a trip, with sufficient capacity to carry a 20-ton trolley locomotive now being installed for underground ore haulage. Sinking methods and equipment will feature some of the most advanced developments in mechanical handling of muck and placement of concrete, it is reported. Some of the equipment to be used will make its first appearance.

A commercial silver mine is announced by operators of Conjecture mine in Northern Idaho. Federal Uranium Corp. has spent two years in developing the Conjecture and is contemplating erection of a 250 tpd mill in 1960 to process the ore.

Uranium researchers at the University of Colorado are seeking new peacetime chemical uses for uranium under grants from AEC.

One study covers investigation of photochemical and thermal nitrating properties of a complex nitrate of uranium which does not occur in nature. It is hoped that study will reveal the compound capable of producing a whole series of important nitro compounds by photosynthesis—substances which now cannot be made at all because of their being subject to deterioration from heat.

Empire Zinc Co. has resumed full-scale operations at its Hanover, N. Mex. zinc properties after an 18-month shutdown.

Alaskan iron ore deposits are undergoing a 20-day survey by a six-man delegation from four of Japan's leading iron and steel companies. Although no purchases have been made, the mission is exploring mines for possible future exploitation.

$16,000,000 facilities of Central Farmers Fertilizer Co. in Bear Lake Co., Idaho were recently dedicated in ceremonies marking the start of commercial production of high-analysis superphosphates. An estimated 140,000 tons per year of superphosphates will be produced in the 35,000-kw elemental furnace.

The Whaley "Automat" has no equal in cost saving on either a per dollar of equipment investment, or per ton of material loaded, or per foot of advance!

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• • •

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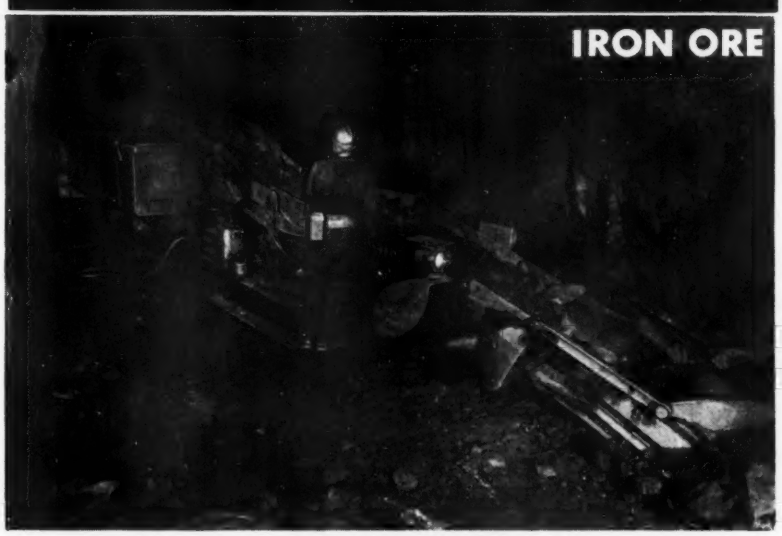

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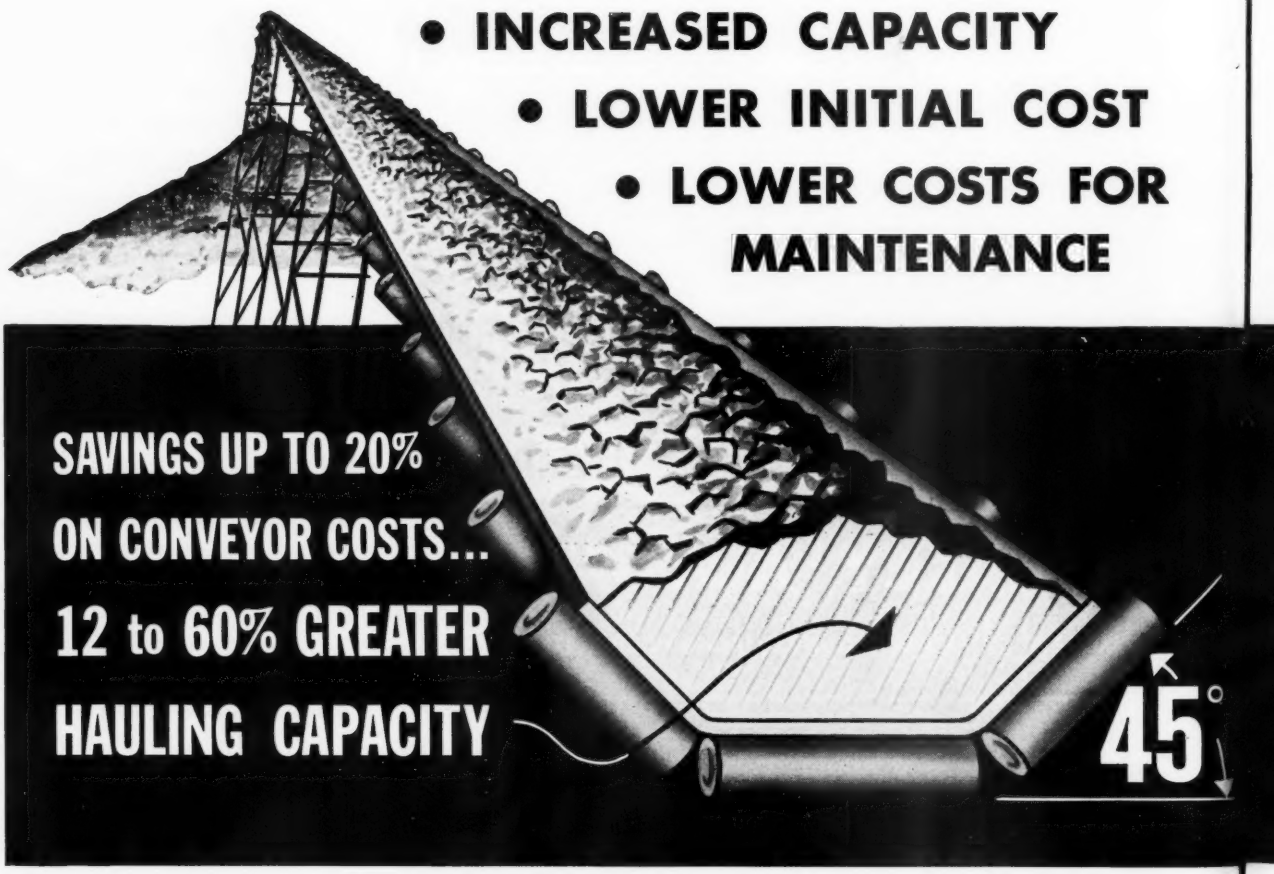

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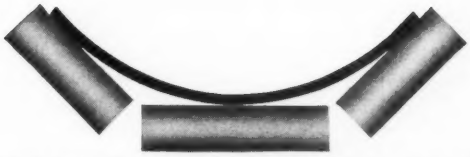

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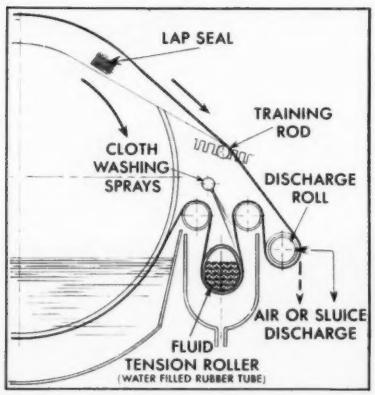
Filtering Advance

A NEW DEVELOPMENT IN filtering technology has been announced by Peterson Filters and Engineering Co. of Salt Lake City, Utah. With a patented "cloth discharger," licensed



by Peterson, it is now possible to continuously remove a fabric medium from a drum filter, wash it thoroughly, and then automatically replace it on the drum.

Key to the success of the device is the water-filled flexible tube which acts as a fluid tension roller and permits the proper tracking of the filter cloth. The Peterson cloth discharger can be designed to fit any size, and most types, of drum filter.

Skid-Shovel

HYDRAULICALLY ADJUSTABLE to duplicate the actions of four specialized machines, the front-end loader, International Drott 4-in-1 Skid-Shovel, has been adapted for use with the International T-340 crawler tractor recently introduced by International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill.

The segmented-type bucket can serve as a standard bucket, a bulldozer, a carry-type scraper and a clamshell. Selection of the desired machine action is made from the tractor seat by means of the machine selector lever, and changeover from one tool to another takes only seconds. Skid-shoes mounted beneath the bucket serve as a fulcrum for strong pryout action.

With a capacity of 5/8 cu yd struck and 7/8 cu yd heaped, the bucket dumps in two ways: conventional roll-forward action, or through the bottom by lifting the front half of the bucket and letting the material fall through.

The New Look

HEAVY EQUIPMENT OPERATORS in our Nation's open pit mines may soon look like space pilots as they drive their machines in hot, dusty locations. Jamieson Laboratories, 2200 Colorado Ave., Santa Mon-

ica, Calif., has introduced an air-conditioned helmet to the mining industry which may well lead to the "Buck Rogers" appearance.

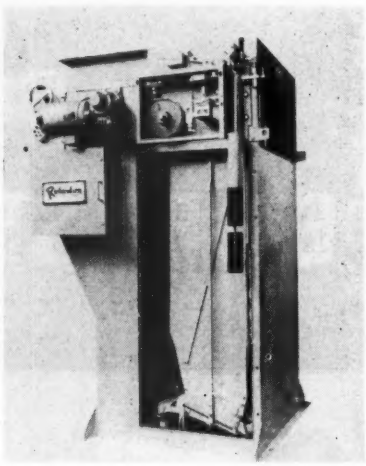
An outgrowth of research on space units, the helmet is attached to a "one-man air conditioner" which cools and dries air, and also filters out dust, insects and other foreign materials. The light weight fibreglass helmet is equipped with a face-plate of clear plastic, and a flexible vinyl air hose connects the helmet and the refrigeration-filter unit. The small electric motor drives the compressor wires into any 12 volt or higher ignition system, or can be converted into a 6-volt system.

Introduce Improved Portable Washing Plant

A COMPLETE LINE of portable washing plants has been announced by Pioneer Engineering, Division of Poor & Co., Minneapolis, Minn. Designed to meet the need for a washing plant that is easy to erect, easy to move and easy to adapt to changing pit conditions, the new line includes several models based on a single design. The basic plant consists of a reciprocating plate feeder, conveyor, deck-vibrating screens and screw classifier, with necessary structural supports. Complete information, including drawings, field reports and detailed specifications, are available from the manufacturer.

1000 Lb Coal Scale

QUICK REMOVAL OF THE WEIGH HOPPER and easy access to any part of the scale for inspection and adjustment is said to be the special feature of a 1000-lb automatic coal scale announced by Richardson Scale Co., Clifton, N. J. Coal enters the scale from the bunker through an



inlet opening with an inside measurement of 24 × 24 in., passing onto a wide rubber belt feeder and is then conveyed to a counter-balanced weigh hopper suspended from the weigh beam.

When the weigh hopper is loaded almost to the pre-set weight, it comes toward balance. Switches, contactors, and a solenoid are actuated by the loaded weight hopper. They stop the belt feeder at balance and the hopper is discharged. A mechanical counter directly linked to the operating levers

registers the number of discharges made by the scale. All main operating levers, linkages and electrical connections are outside the dust-tight scale housing and protected by covers.

Wood Preservative

EASY APPLICATION with brush, spray or quick drip is claimed for Carbolineum, wood preservative manufactured by Carbolineum Wood Preserving Co., 6683 N. 40th St., Milwaukee 9, Wis. Additional features reported advantageous are quick drying, no bleed or ooze, and facility of use by companies themselves without outside help. The material is applicable for shaft timbers, tipples, washeries, track ties, chutes, platforms, props, poles, and wooden buildings.

U-Shaped Bulldozer

DEVELOPED FOR COAL STORAGE and reclaiming operations, and completely interchangeable with standard Caterpillar bulldozer blades, is an improved U-shaped bulldozer recently announced by Balderson Inc., Wamego, Kans.

The Balderson BD9U-20′ features a higher moldboard designed to roll the coal higher, practically eliminating top spillage. Side wings are angled forward at 25° to keep side spillage to a minimum. This blade is said to have a greater over-all capacity than its predecessor model enabling the bulldozing of huge coal loads.

Countershaft Brake

INCORPORATED AS STANDARD EQUIPMENT on all Fuller Transmissions designed for heavy-duty, off-highway service is an air-powered countershaft inertia brake said to permit fast, easy up shifts without double clutching.

Pre-selected by the operator simply by pressing a button, the brake slows the rotation of the transmission countershaft, main drive gear and clutch driven plate. Actuation is automatic as the transmission is shifted through neutral, and because there is no need for the operator to double clutch, deceleration of the vehicle is held to a minimum.

The brake system provides a time cycle of 2/10 second during each application, at the end of which time the brake system is exhausted and the pre-select valve automatically resets for further use.

Further information is available upon request from Fuller Mfg. Co., Transmission Div., Kalamazoo, Mich.

Cap Lamp

INCREASE IN ILLUMINATION by 15 percent and reduction in over-all weight are the important features reported for a new Edison cap lamp developed by Mine Safety Appliances Co., Pittsburgh, and McGraw-Edison Co., West Orange, N. J.

The lamp approved by the U. S. Bureau of Mines features a simple bezel ring focusing arrangement which is quickly positioned without the aid of focusing tools. The reflector, lens, bulb, and housing are engineered and designed to function as one unit to produce a positive "spot" and achieve brightest possible illumination. The krypton-gas-filled bulb has two identical filaments, each having a 400-hr service rating. Should one filament burn out, a simple headpiece switch energizes the other filament so that the same amount of light is available to finish the work shift.

A new active material has been added to the Edison nickel-iron-alkaline battery, and has been tested under severe operating conditions to prove increased dependability, longer service life, and more operating economy. Further complete details can be obtained by writing to M-S-A, 201 N. Braddock Ave., Pittsburgh 8, Pa., and asking for Bulletin No. 0201-6.

—ANNOUNCEMENTS—

Arthur E. Shannon has resigned from **Jeffrey Mfg. Co.** to join the **Lee-Norse Co.** sales organization. He will be in charge of the Tri-State area (Pennsylvania, northern West Virginia and eastern Ohio), working out of the main office located in Charleroi, Pa. Shannon replaces the late **Edward Phillips.**

A. E. Shannon

D. K. HEIPLE has been named manager of a newly formed Sales Development Department at **LeTourneau-Westinghouse Co.**

Associated with L-W for the past 17 years, Heiple has served as the company's chief field engineer since 1948. In connection with his duties he has held the position of secretary of the firm's Product Development Committee. In his new post, he will continue to have charge of Field Engineering activities and in addition will be responsible for the company's Marketing Research and Sales Engineering programs.

Fairmont Machinery Company has acquired all the outstanding capital stock of **Lecco Machinery and Engineering Company** of Bluefield, W. Va.

Lecco manufactures horizontal and inclined vibrating screens and vibrating conveyors which are widely used in the coal, stone, phosphate and iron ore industries.

Lecco will be operated as a wholly owned subsidiary of Fairmont Machinery with headquarters in Bluefield. **Joseph W. Wantling,** president of Lecco since its incorporation in 1954, will continue as president under the new ownership.

Harnischfeger Corp. has named **Louis A. Flora** as director of advertising and sales promotion for the company's Construction and Mining Division.

Marion Power Shovel Co. recently announced the appointment of **George W. Boulter** as assistant manager of the Mining Division. Boulter was formerly safety director of the Montana State Highway Department, and has had over 20 years experience in various operating capacities in the non-ferrous metal mining industry.

G. W. Boulter

(*Catalogs & bulletins next page*)

CATALOGS & BULLETINS

EXPLOSION-PROOF MINE MOTORS. *General Electric Co., Schenectady 5, N.Y.* Bulletin GEA-6974 is illustrated and lists the advantages, applications, types and characteristics of General Electric continuous mining machine motors in the Direct Current, Type MDY-500 series. The new motor is totally enclosed, non-ventilated, and fan-cooled.

BORING, FACING AND THREADING TOOLS. *Comet Tool Co., 738 Broadway, New York 3, N.Y.* Seventeen different sizes for precision boring, facing, and internal threading tools for holes from 1/16" diam and up are listed in this brochure. Also featured are new "Solid Carbide Insert" boring tools as well as complete Jig boring sets.

PROPELLER AND MIXED FLOW PUMPS. *Layne & Bowler, Inc., Memphis 8, Tenn.* This complete and detailed bulletin gives information on all uses and application of these pumps and includes cut away drawings, installation sketches and measurements, delivery and performance tables. Free on request.

FILTERING COSTS. *Caterpillar Tractor Co., Peoria, Ill.* Entitled "Three Questions", this booklet asks and answers—"What does filtering really cost me?"; "Aren't all elements about the same?"; "Honestly, how often should elements be changed?". The booklet explains that filtering costs depend on the quality of the element; poorly designed and "cost-cutting" substitute filters often cost more in long run than those recommended by equipment manufacturers; and elements should be changed, according to the book, when the filter's dirt-holding capacity has been reached. More complete details can be obtained by asking Caterpillar for Form DE928.

FUNDAMENTALS OF METAL REPAIR. *Forney Arc Welders, Inc., Box 563, Fort Collins, Colo.* This 210-page illustrated manual is organized in forty-three chapters to present instructions, practical working tips, exercises that can be performed as self-teaching aids, and questions and answers concerning the use of a single piece of equipment as an arc welder, carbon arc torch and soldering iron to provide a complete range of metal repairs with a minimum of investment. Price of manual is $2.50. Quantity prices are available by writing to Forney.

TRACTOR SHOVEL. *Yale & Towne Manufacturing Co., Trojan Division, Batavia, N.Y.* Just released is a specification bulletin explaining production and operation features of the new Model 204 Trojan tractor shovel. Of particular interest to bulk material producers and contractors is the fact that the 204 has three interchangeable buckets, giving the machine a carrying capacity of from 1½ to 2¾ yards.

BRUSHLESS GENERATOR. *Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.* Bulletin 51B9192 discusses characteristics of Allis-Chalmers high-speed, packaged brushless synchronous generators in 40 to 300-kw ratings. The key to the generator's design is provided by a combination of brushless excitation system and static voltage regulation control. In the former, commutators and brushes are replaced by silicon rectifiers, while in the latter constant voltage is provided up to plus or minus ½ precent regulation regardless of load or normal frequency variation.

H & P FLUID BED DRYER. *Heyl & Patterson, Inc., 55 Fort Pitt Blvd., Pittsburgh 22, Pa.* Brochure 159 describes the new H & P Fluid Bed Dryer of which there are now four in operation and several more under construction. The brochure is illustrated with cut-away views and pictures of field installations.

"WAREHOUSE LAYOUT: NARROW AISLES OR WIDE?" *Automatic Transportation Co., 149 West 87th St., Chicago, Ill.* This eight-page brochure is designed as a guide to give both advantages and disadvantages to the costly problem described in the title. It is reported as being helpful for material handling engineers in deciding which type of warehouse is best for his installation. Discussed is the history of the narrow versus wide aisle problem along with the changes that have been made through the introduction of new material handling equipment. Four pages are devoted to illustrating how Automatic equipment is used to solve the problems being discussed.

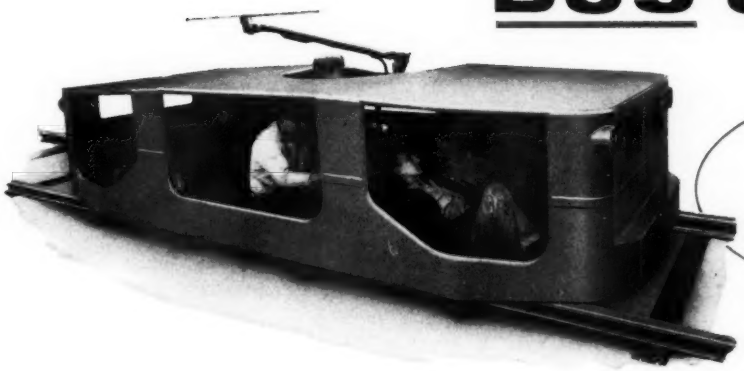
Index to Advertisers

coming and going

you take your profits on ~~the~~ every run

with the **Lee-Norse**

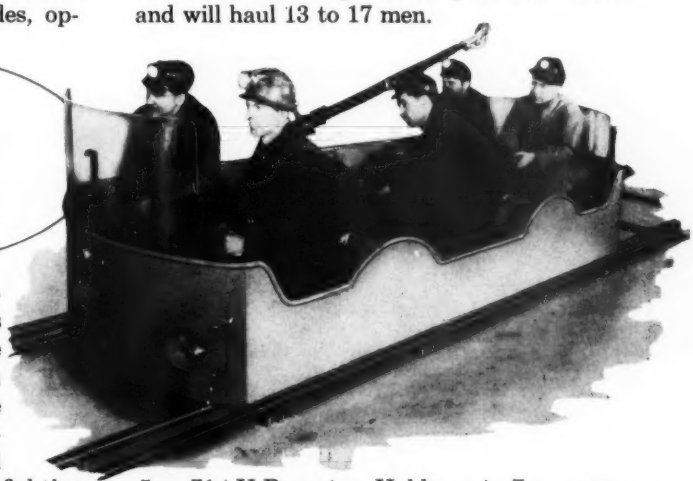
BUS & JITNEY



Lee-Norse
MINE PORTAL BUS

■ There's no wasted motion with this self-propelled Portal Bus because it is fast on the take-off, saving manpower time for conversion into more tonnage. And it is designed for safety, with hydraulic operated running brakes plus mechanical emergency and parking brakes direct on the wheels. For severe grades, optional electric dynamic system produces braking effect from the motor for *extra* safety under all conditions. Also the split roof construction gives operator unimpeded, all directional view, while the trolley pole is always within quick reach. This bus is powered by 15 H.P. motor and will haul 13 to 17 men.

Lee-Norse
MINE JITNEY



■ The Mine Jitney is the "Jack-of-all-Trades" of the mine fleet because its versatility enables it to be used on the regular job and for emergency. It can handle the job of furnishing fast, safe transportation of key personnel, maintenance crews and special groups; and can double up as an ambulance or fire-fighting equipment car. Designed with twin braking systems for added safety. Powered with either 5 or 7½ H.P. motor. Holds up to 7 men comfortably. Optional equipment: Plexiglas windshield, fire extinguisher, stretcher equipment.

LN

Lee-Norse Company

CHARLEROI, PENNSYLVANIA

SPECIALISTS IN COAL MINING EQUIPMENT

Now—more light, less weight, longer life with

NEW EDISON MODEL S ELECTRIC CAP LAMP

MSA announces another new *high* in lighting efficiency in the world's most popular cap lamp. Increased light output of the new Edison Model S Lamp assures greater safety for the miner, more tons per shift for the operator. Let's face a fact: Dimness costs money. *Fair* lighting does only a *fair* job. Maximum lighting—the brilliant, unfailing Edison Model S kind—helps get jobs done with top speed and safety. And the simplified method of charging new Model S Batteries—with the AUTOMATIC LOW-VOLTAGE SYSTEM—is convenient, thrifty and highly efficient. Lets miners take their lamps and rack them—quickly—without loss of time or waste motion. When planning a new lamphouse installation or modernizing your present one, call in the MSA Representative. MSA can help you solve your lighting problems.

Newly issued U.S. Bureau of Mines Approval 6D-31, April 16, 1959.

MSA SAFETY EQUIPMENT HEADQUARTERS

MINE SAFETY APPLIANCES COMPANY • 201 North Braddock Avenue, Pittsburgh 8, Pennsylvania

MINE SAFETY APPLIANCES CO. OF CANADA, LIMITED • Toronto, Calgary, Edmonton, Montreal, Sydney, Vancouver, Winnipeg

Look how small the headpiece is. Weighs only a few ounces. Feels even lighter on the head. You get a clear, sharp spot every time.

Increase in working light appeals to me. This new Edison Model S gives 15% more than we ever had before. And they didn't cut their bulb service life rating to do it. The double filament bulb means we'll always have working light to finish the shift. Each filament of the Edison Model S krypton-gas-filled bulb has a 400-hour designed life.

Just watch the improvement in our safety and tonnage reports. More light. Less weight. Longer life. Even the battery's better. It has a new active material that boosts service life. They went all-out to meet the miner's needs with this one.